United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Mahnomen County, Minnesota

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How To Use This Soil Survey

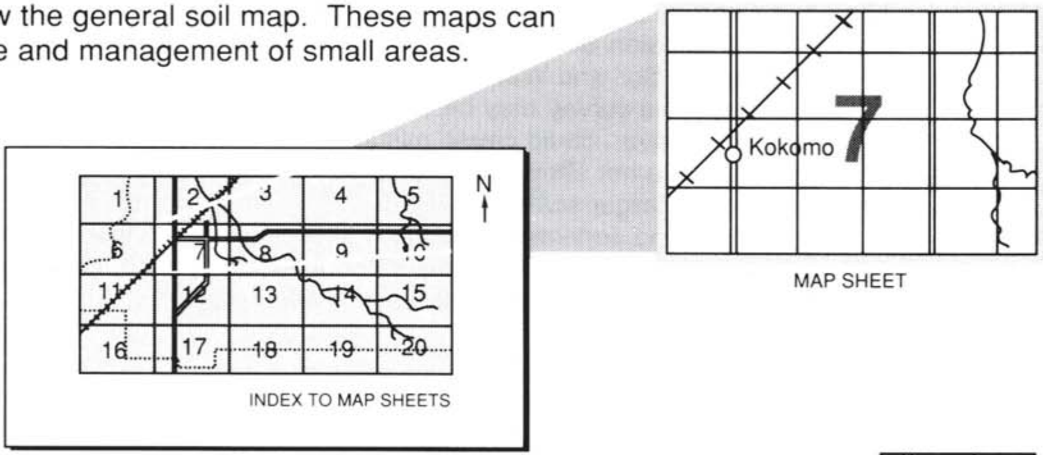
General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

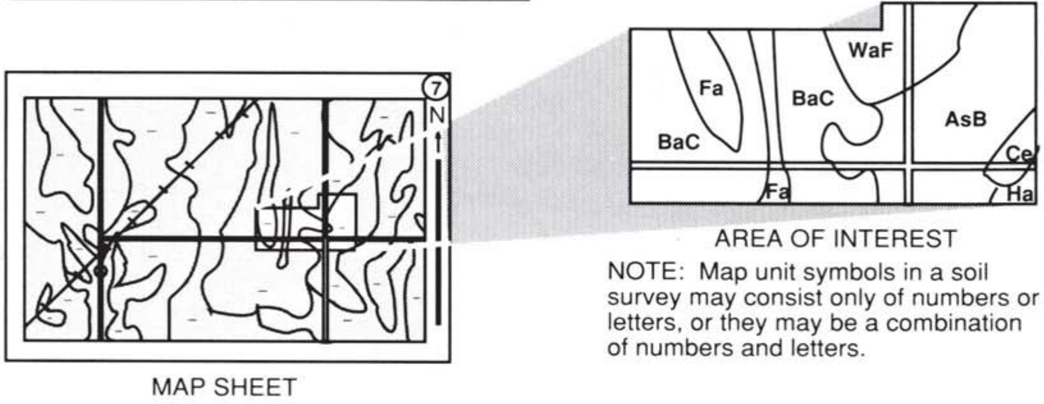
To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.



To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1991. Soil names and descriptions were approved in 1992. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1991. This survey was made cooperatively by the Natural Resources Conservation Service and the Minnesota Agricultural Experiment Station. It is part of the technical assistance furnished to the Mahnomen County Soil and Water Conservation District. The survey was partially funded by the Legislative Commission for Minnesota Resources and by Mahnomen County. Other assistance was provided by the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Board of Soil and Water Resources.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Windrows of small grain in an area of the Barnes-Langhei association. Most areas of this association are used as cropland.

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Foreword

This soil survey contains information that can be used in land-planning programs in Mahnomen County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

William Hunt
State Conservationist
Natural Resources Conservation Service

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Soil Survey of
Mahnomen County, Minnesota

By Gary D. Nelson, Natural Resources Conservation Service

Fieldwork by Gary D. Nelson, Russel J. Kelsea, and Peter B. Whitcomb, Natural Resources Conservation Service, and James A. Barott, Minnesota Agricultural Experiment Station

United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
the Minnesota Agricultural Experiment Station

MAHNOMEN COUNTY is in the northwestern part of Minnesota (fig. 1). It has a total area of 373,300 acres, or 583 square miles. Of this total, 15,500 acres, or 4 percent, is water. The city of Mahnomen is the county seat.

About two-thirds of the county is farmland, and most of the remaining land is woodland. Barley and wheat are the main crops. Corn, soybeans, and hay are also grown. Dairy cattle, beef cattle, and hogs are the main livestock raised in the county.

The original vegetation in the western part of the county was primarily tall grass prairie. Mixed hardwoods and some conifers are in the eastern part of the county.

Most of the soils in Mahnomen County formed in glacial till, but there are some areas of glacial outwash. Much of the western part of the county is nearly level to rolling. The landscape is gently undulating and hilly in the eastern part of the county.

General Nature of the County

This section provides general information about Mahnomen County. It describes history and settlement; climate; transportation facilities and markets; natural resources; agriculture; and physiography, relief, and drainage.

History and Settlement

The survey area was originally inhabited by the Ojibway Indians. In 1887, the White Earth Indian Reservation, which included all of Mahnomen County, was established. Also during the 1800's, one of the Red

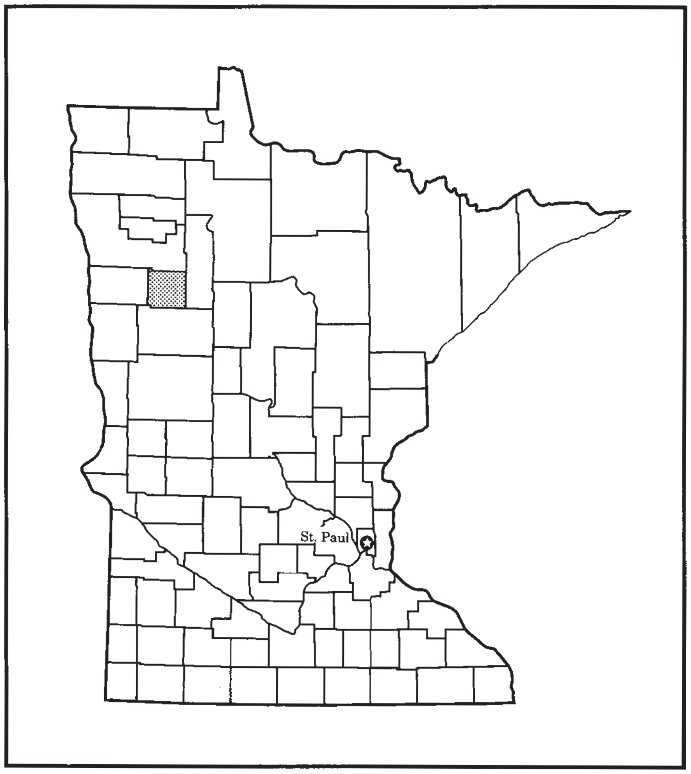

Figure 1.—Location of Mahnomen County in Minnesota.

River oxcart trails, known as the Woods Trail, passed through the southwest corner of the survey area. The trail crossed the Wild Rice River about 4 miles west of the city of Mahnomen.

The Soo Line completed a railroad through the area in 1904. The towns of Mahnomen, Waubun, and Bejou were developed because of their access to the railroad. The city of Mahnomen was established in April 1905, and Mahnomen County was established in December 1906. "Mahnomen" is the Ojibway word for wild rice.

Mahnomen County was previously the eastern part of Norman County. The passage by Congress of the Clapp Act in 1906 allowed reservation land to be sold to non-Indians. The passage of this act resulted in a land boom, and settlement was rapid. In 1910, the population of Mahnomen County was 3,249; in 1940, it was 8,054. By 1980, the population of the county had declined to 5,535 (Andriot, 1983).

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Mahnomen in the period 1961 to 1990. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 8 degrees F and the average daily minimum temperature is -2 degrees. The lowest temperature on record, which occurred at Mahnomen on January 16, 1977, is -44 degrees. In summer, the average temperature is 67 degrees and the average daily maximum temperature is 79 degrees. The highest recorded temperature, which occurred at Mahnomen on August 19, 1976, is 103 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 23.31 inches. Of this, about 16.85 inches, or 72 percent, usually falls in April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall on record was 4.5 inches at Mahnomen on May 29, 1949. Thunderstorms occur on about 32 days each year, and most occur in July.

The average seasonal snowfall is 39.6 inches. The greatest snow depth at any one time during the period of record was 28 inches. On the average, 12 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year. The heaviest 1-day snowfall on record was 16 inches.

The average relative humidity in midafternoon is about 62 percent. Humidity is higher at night, and the average at dawn is about 81 percent. The sun shines 67 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 14 miles per hour, in April.

Transportation Facilities and Markets

The primary means of transportation in Mahnomen County is either by road or rail. The Soo Line transports grain from Mahnomen, Waubun, and Bejou. Most of the grain is sent to Minneapolis or Duluth for shipment to other regions.

Much of the grain produced in the county is trucked to markets in Duluth and Minneapolis. Most livestock is transported by truck to markets in St. Paul or in Fargo, North Dakota. The milk produced in the county is trucked to Fargo.

The road system in Mahnomen County is extensive. Some roads are paved, but many are gravel. The primary north-south route is U.S. Highway 59. State Highways 200 and 113 provide routes east and west. County Highway 1 runs east and west through the village of Bejou; County Highway 2 runs north and south near the center of the county; County Highway 3 runs north and south through the village of Beaulieu; and County Highway 4 runs north and south through the villages of Naytahwaush and MahKonce.

Mahnomen County has an airport for small planes south of the city of Mahnomen.

Natural Resources

Mahnomen County has a wide variety of natural resources. The survey area is in a transitional zone where the forest in the east gradually changes to the prairie in the western part of the county. This transitional feature allows for a rich diversity in plants and animals. Water also plays an important role in the county's resource base.

The eastern part of the county is characterized by hardwood forest. Oak, maple, basswood, aspen, and birch are the dominant tree species. In areas on the glacial outwash plain, conifers, such as red pine and jack pine, are the dominant species. The western part of the county still has some remaining tracts of prairie. These areas support numerous forbs and species of grasses, such as big bluestem, little bluestem, indiangrass, and cordgrass. The yearly dying and decomposition of these tall grass prairies over a period of thousands of years contributed to the formation of the thick, dark, fertile soils in this part of the survey area.

Water is an important natural resource in Mahnomen County. The lakes provide many recreational opportunities, such as fishing and boating. The rivers, lakes, and marshes also provide habitat for a wide variety of plants and animals. Abundant ground-water supplies provide good-quality water for domestic and commercial uses.

Agriculture

The major crops grown in Mahnomen County are barley and wheat. Corn, soybeans, and hay are also important. Between 1975 and 1987, the acreage used for barley more than doubled but the acreage used for wheat remained relatively stable. During the same period, the production of corn increased about 25 percent and the production of soybeans more than doubled. The production of hay decreased by about 20 percent (Minnesota Agricultural Statistics Service, 1975 and 1989).

Livestock production is also important in the county. Between 1975 and 1987, the production of dairy cows declined by about 30 percent and that of beef cattle declined by about 35 percent. The production of hogs increased by about 18 percent (Minnesota Agricultural Statistics Service, 1975 and 1989).

In general, barley, wheat, and soybeans are the dominant crops in the western part of the county and corn, hay, and livestock are more important in the eastern part.

The number of farms in the county is declining, but the average farm size has increased. About 65 percent of the county is farmland.

Physiography, Relief, and Drainage

The landscape of Mahnomen County is primarily the result of glacial activity. The county can be divided into four areas of glacial deposition (fig. 2). These are the Erskine ground moraine and the Big Stone stagnation moraine of the Des Moines lobe, the Itaska end moraine of the Wadena lobe, and the glacial outwash valley train (Hobbs and Goebel, 1982). The glacial till of the Des Moines and Wadena lobes is similar, except that the till of the Wadena lobe contains more sand and slightly less clay. Glacial outwash consists of sorted sands and gravels.

The ground moraine of the Des Moines lobe in the western half of the county is a nearly level to gently undulating, complex area with many depressions and small convex rises. Some steeper slopes are near creeks or rivers. The stagnation moraine of the Des Moines lobe in eastern Mahnomen County is an upland area consisting of complex slopes and many depressions and natural draws. Slopes in this area range from gently undulating to steep. The end moraine of the Wadena lobe in the southeast corner of the county is an upland area characterized by complex, short slopes and closed depressions. Slopes range from undulating to steep.

The major glacial outwash area runs from the northeast corner of the county toward the southwest, through the Twin Lakes and into Becker County. The relief is nearly level, and the landscape is characterized by some large marshes and deep lakes.

The highest elevation in Mahnomen County, about 1,795 feet above sea level, is near the southeast corner of the county. The lowest elevation, about 1,130 feet, is at the Wild Rice River on the western edge of the county.

The Wild Rice River, which flows west into the Red River of the North, is the major river in Mahnomen County. The White Earth River, Marsh Creek, Spring Creek, and Twin Lakes Creek all drain into the Wild Rice River. An area near Sandhill Lake and the northwest corner of the county are drained by the Sandhill River, which also flows west into the Red River of the North.

Mahnomen County has many lakes, bogs, and marshes, which receive much of the runoff from the surrounding landscape. The lakes, bogs, and marshes act as natural catch basins for flood control, but they are continually becoming shallower as they are filled with eroded sediment. This sedimentation of lakes and marshes contributes to increased flooding of creeks and rivers after periods of heavy rainfall. The installation of artificial drainage systems also contributes to this flooding.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil

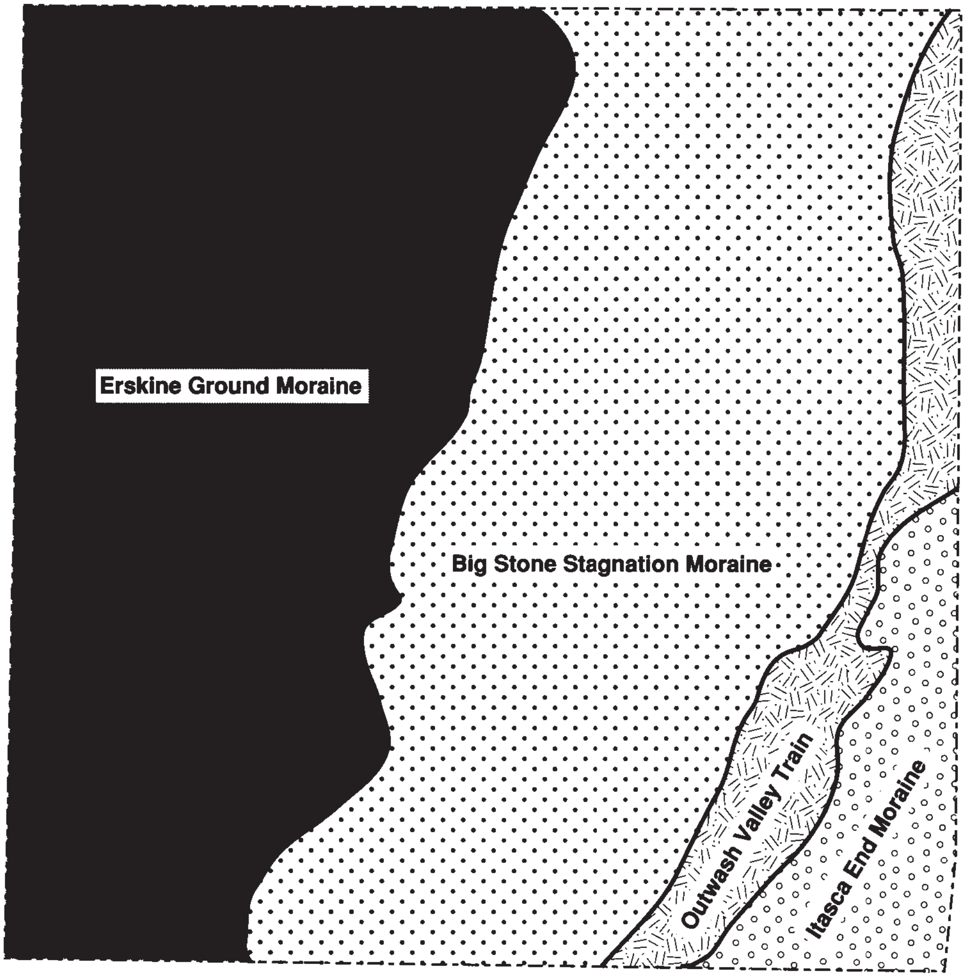

Figure 2.—Glacial geomorphic map of Mahnomen County.

formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Some soil names and boundaries on the soil maps of this survey may not fully agree with those of the surveys of adjoining areas that were published at an earlier date. The differences are the result of changes and refinements in series concepts, variations in slope groupings, and the application of the latest soil classification system.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called similar inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

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General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Descriptions

1. Hamerly-Vallers Association

Moderately well drained, somewhat poorly drained and poorly drained, nearly level and gently sloping soils that formed in loamy glacial till on moraines

Setting

Landform and position on the landform: Slightly convex rises and broad flat areas on moraines (fig. 3)
Slope range: 0 to 3 percent

Composition

Percent of survey area: 23
Extent of components in the association:
Hamerly soils—45 percent
Vallers soils—40 percent
Minor soils—15 percent

Soil Properties and Qualities

Hamerly
Drainage class: Moderately well drained and somewhat poorly drained
Parent material: Glacial till
Surface texture: Clay loam

Vallers
Drainage class: Poorly drained
Parent material: Glacial till
Surface texture: Silty clay loam

Minor Soils

- The very poorly drained Hamre and Quam soils in depressions
- The poorly drained Flom soils in swales
- The well drained Barnes and Langhei soils on side slopes along drainageways

Use and Management

Major use: Cropland; about 95 percent of the association is used for cultivated crops, mostly barley and wheat.
Major management factors: Hamerly—high pH, wind erosion; Vallers—seasonal high water table, high pH, wind erosion

2. Barnes-Langhei Association

Well drained, undulating to hilly soils that formed in loamy glacial till on moraines

Setting

Landform and position on the landform: Convex hilltops and side slopes on moraines (fig. 4)
Slope range: 2 to 20 percent

Composition

Percent of survey area: 16
Extent of components in the association:
Barnes soils—45 percent
Langhei soils—30 percent
Minor soils—25 percent

Soil Properties and Qualities

Barnes
Drainage class: Well drained
Parent material: Glacial till
Surface texture: Loam

Langhei
Drainage class: Well drained

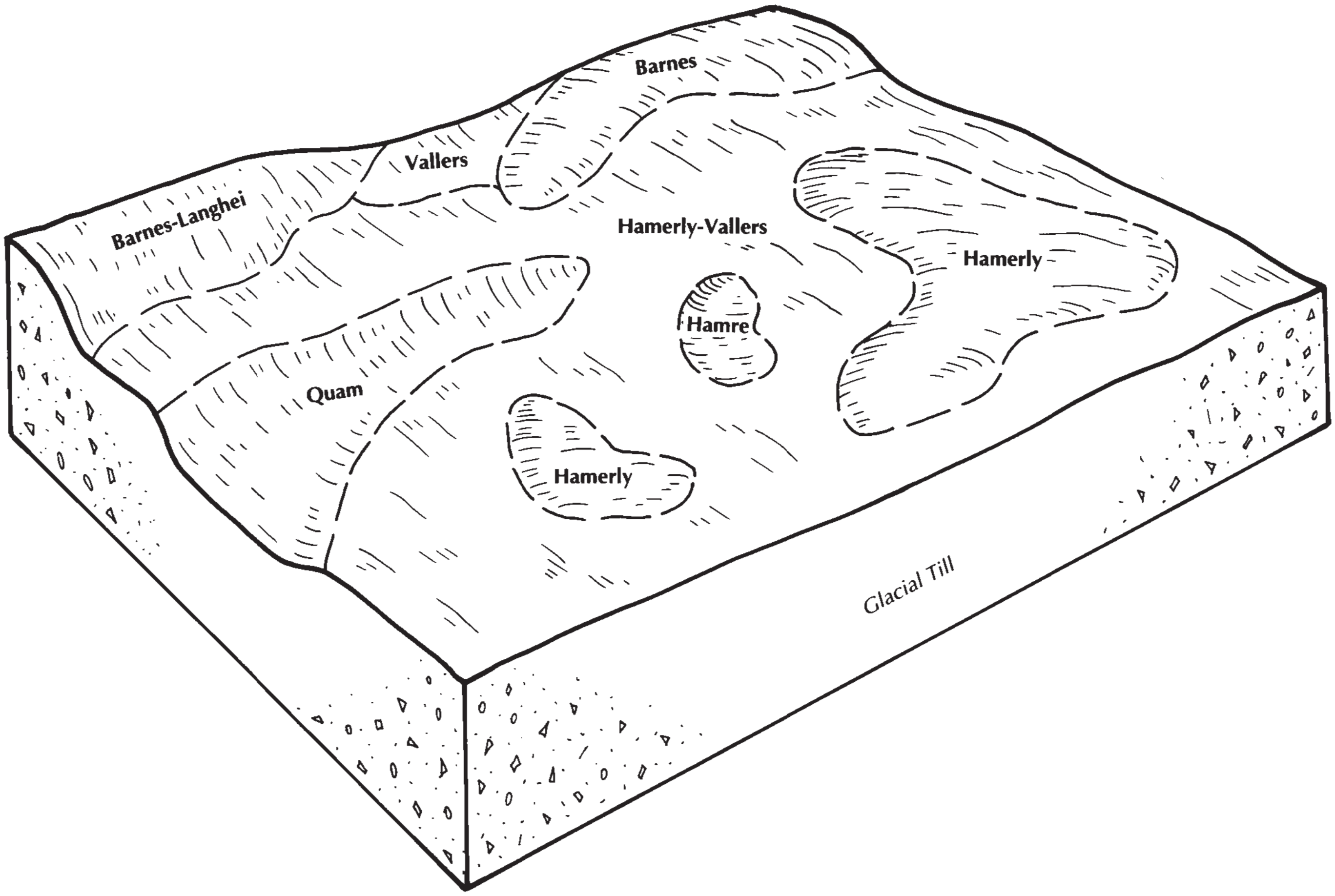

Figure 3.—Typical pattern of soils and parent material in the Hamerly-Vallers association.

Parent material: Glacial till
Surface texture: Loam

Minor Soils

- The poorly drained Flom and Vallers soils in swales and broad flat areas
- The moderately well drained Hamlet soils on slightly concave hilltops
- The very poorly drained Quam and Hamre soils in depressions
- The moderately well drained Darnen soils on foot slopes

Use and Management

Major use: Cropland; about 90 percent of the association is used for cultivated crops, mostly barley, wheat, and soybeans.
Major management factors: Barnes—slope, water erosion; Langhei—slope, water erosion, organic matter content, high pH

3. Hedman-Fram-Heimdal Association

Poorly drained, somewhat poorly drained, moderately well drained, and well drained, nearly level to hilly soils that formed in loamy glacial till on moraines

Setting

Landform and position on the landform: Broad flat areas, slightly convex rises, and side slopes on moraines
Slope range: 0 to 20 percent

Composition

Percent of survey area: 10
Extent of components in the association:
Hedman soils—40 percent

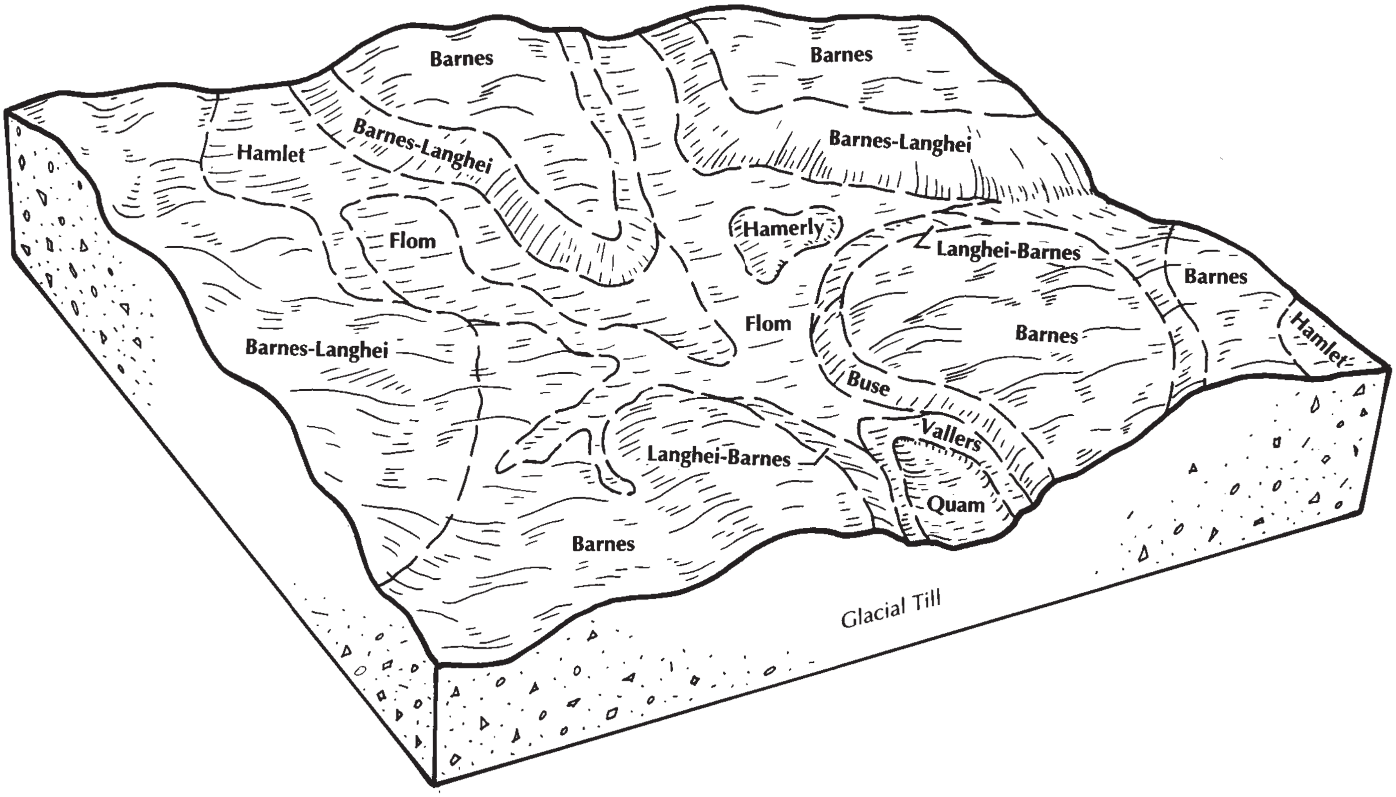

Figure 4.—Typical pattern of soils and parent material in the Barnes-Langhei association.

Fram soils—30 percent
Heimdal soils—15 percent
Minor soils—15 percent

Soil Properties and Qualities

Hedman
Drainage class: Poorly drained
Parent material: Glacial till
Surface texture: Loam

Fram
Drainage class: Somewhat poorly drained and moderately well drained
Parent material: Glacial till
Surface texture: Loam

Heimdal
Drainage class: Well drained
Parent material: Glacial till
Surface texture: Loam

Minor Soils

- The very poorly drained Hamre and Cathro soils in depressions
- The well drained Esmond soils on side slopes along drainageways

Use and Management

Major use: Cropland; about 90 percent of the association is used for cultivated crops, mostly barley and wheat.
Major management factors: Hedman—seasonal high water table, high pH; Fram—high pH, wind erosion; Heimdal—slope, water erosion

4. Waukon-Langhei-Flom Association

Well drained and poorly drained, nearly level to steep soils that formed in loamy glacial till on moraines

Setting

Landform and position on the landform: Convex side slopes and swales on moraines (fig. 5)
Slope range: 0 to 30 percent

Composition

Percent of survey area: 14
Extent of components in the association:
Waukon soils—40 percent
Langhei soils—25 percent
Flom soils—10 percent
Minor soils—25 percent

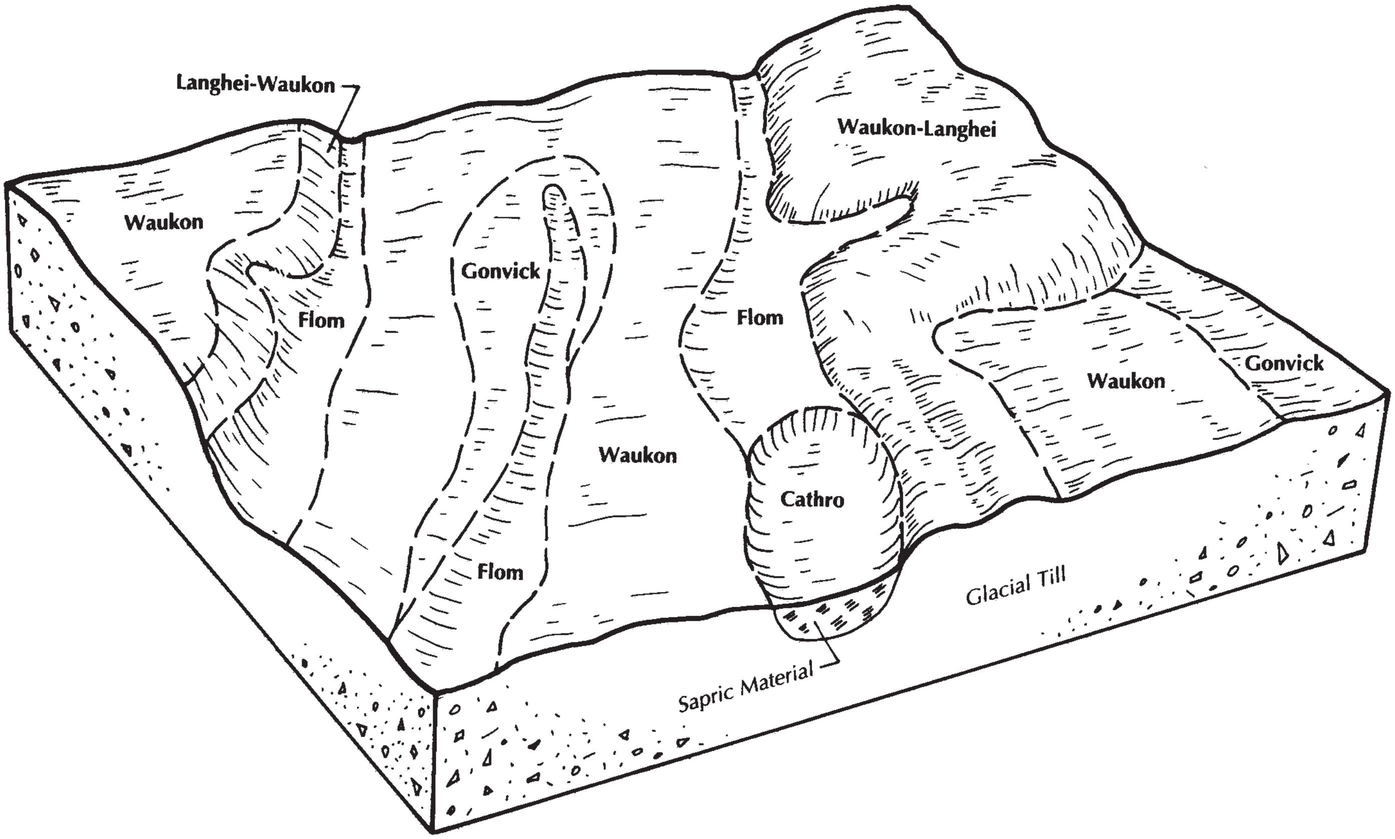

Figure 5.—Typical pattern of soils and parent material in the Waukon-Langhei-Flom association.

Soil Properties and Qualities

Waukon
Drainage class: Well drained
Parent material: Glacial till
Surface texture: Loam

Langhei
Drainage class: Well drained
Parent material: Glacial till
Surface texture: Loam

Flom
Drainage class: Poorly drained
Parent material: Glacial till
Surface texture: Silty clay loam

Minor Soils

- The moderately well drained Gonvick soils on slightly concave hilltops
- The moderately well drained Darnen soils on foot slopes
- The very poorly drained Hamre, Cathro, and Seelyeville soils in depressions

Use and Management

Major uses: Cropland and woodland; about 70 percent of the association is used for cultivated crops, mostly barley and wheat, and about 25 percent is deciduous forest.

Major management factors: Waukon—slope and water erosion on cropland, equipment limitations and plant competition on woodland; Langhei—slope, water erosion, organic matter content, high pH on cropland, equipment limitations and plant competition on woodland; Flom—seasonal high water table on cropland, equipment limitations and plant competition on woodland

5. Naytahwaush-Mahkonce-Auganaush Association

Well drained, moderately well drained, and poorly drained, nearly level to steep soils that formed in loamy and silty glacial till on moraines

Setting

Landform and position on the landform: Convex side

slopes, plane and slightly concave hilltops, and swales on moraines
Slope range: 0 to 30 percent

Composition

Percent of survey area: 16
Extent of components in the association:
Naytahwaush soils—50 percent
Mahkonce soils—15 percent
Auganaush soils—15 percent
Minor soils—20 percent

Soil Properties and Qualities

Naytahwaush
Drainage class: Well drained
Parent material: Glacial till
Surface texture: Loam

Mahkonce
Drainage class: Moderately well drained
Parent material: Glacial till
Surface texture: Loam

Auganaush
Drainage class: Poorly drained
Parent material: Glacial till
Surface texture: Loam

Minor Soils

- The very poorly drained Hamre, Cathro, and Seelyeville soils in depressions

Use and Management

Major uses: Woodland, cropland; about 80 percent of the association is deciduous forest, and about 15 percent is used for hay and cultivated crops, mostly barley and wheat.
Major management factors: Naytahwaush—equipment limitations, seedling mortality, windthrow hazard, plant competition on woodland, slope and clay content on cropland; Mahkonce—equipment limitations, seedling mortality, windthrow hazard, plant competition on woodland; Auganaush—equipment limitations, seedling mortality, windthrow hazard, plant competition on woodland, wetness on cropland

6. Nebish-Beltrami Association

Well drained and moderately well drained, very gently sloping to steep soils that formed in loamy glacial till on moraines

Setting

Landform and position on the landform: Convex side slopes and plane and slightly concave hilltops on moraines
Slope range: 1 to 30 percent

Composition

Percent of survey area: 5
Extent of components in the association:
Nebish soils—50 percent
Beltrami soils—15 percent
Minor soils—35 percent

Soil Properties and Qualities

Nebish
Drainage class: Well drained
Parent material: Glacial till
Surface texture: Loam

Beltrami
Drainage class: Moderately well drained
Parent material: Glacial till
Surface texture: Loam

Minor Soils

- The poorly drained Talmoon soils in swales and shallow depressions
- The very poorly drained Hamre, Cathro, and Seelyeville soils in depressions

Use and Management

Major use: Woodland; about 90 percent of the association is deciduous forest.
Major management factors: Equipment limitations, plant competition, erosion hazard

7. Sugarbush-Graycalm Association

Well drained and somewhat excessively drained, very gently sloping to very steep soils that formed in sandy glacial outwash on outwash plains, valley trains, and moraines

Setting

Landform and position on the landform: Broad flat areas and convex side slopes on outwash plains, valley trains, and moraines
Slope range: 1 to 30 percent

Composition

Percent of survey area: 9
Extent of components in the association:
Sugarbush soils—60 percent
Graycalm soils—15 percent
Minor soils—25 percent

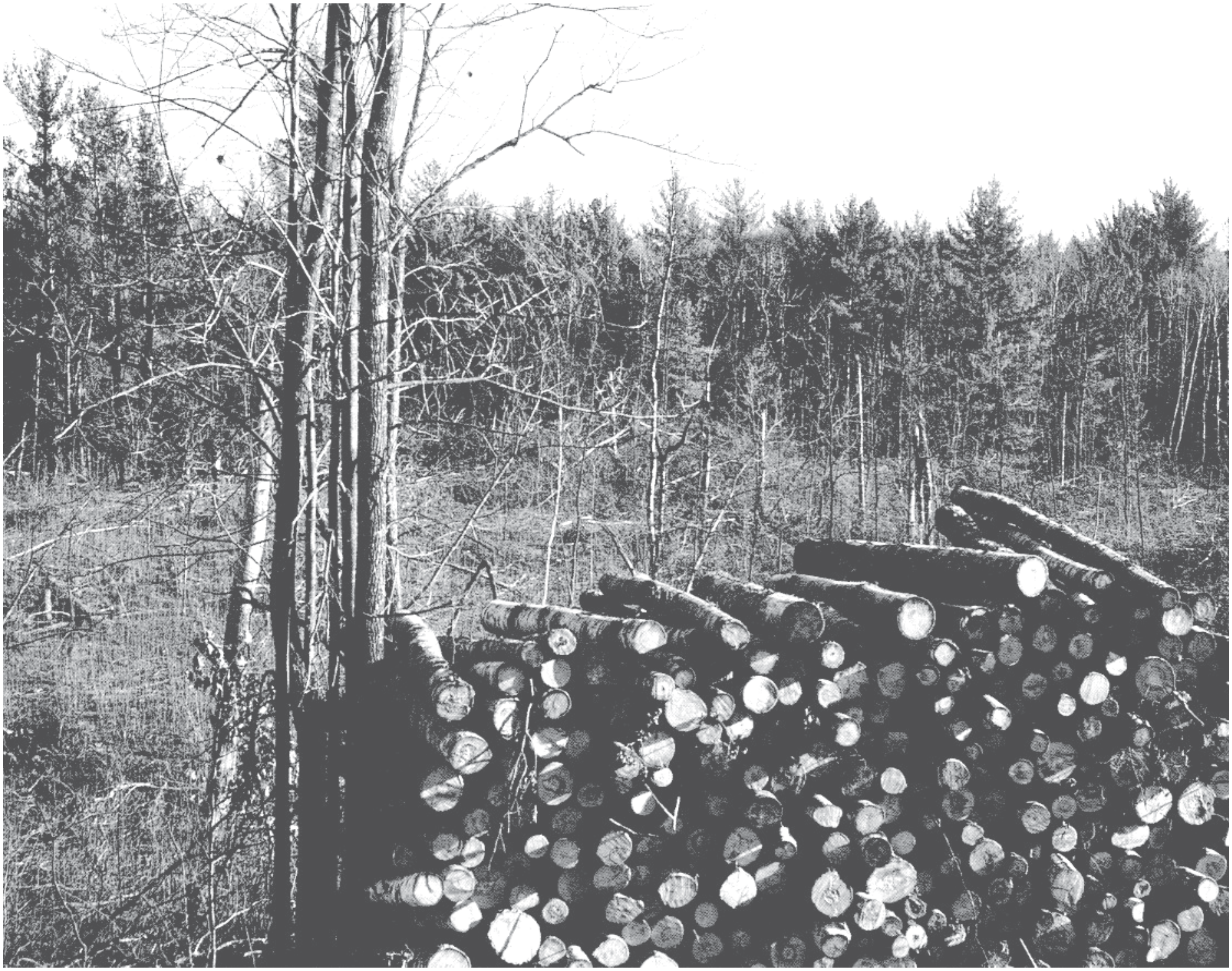

Figure 6.—Pulpwood harvested from an area of the Snellman-Sugarbush association.

Soil Properties and Qualities

Sugarbush

Drainage class: Well drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Graycalm

Drainage class: Somewhat excessively drained
Parent material: Glacial outwash
Surface texture: Loamy sand

Minor Soils

- The excessively drained Menahga soils on side slopes
- The somewhat excessively drained Two Inlets soils on convex hilltops and side slopes
- The very poorly drained Markey and Seelyeville soils in depressions
- The poorly drained Epoufette soils in swales and shallow depressions
- The moderately well drained Karlstad soils in plane and slightly concave areas

Use and Management

Major use: Woodland; about 95 percent of the association is deciduous forest.

Major management factors: Equipment limitations, plant competition, erosion hazard

8. Snellman-Sugarbush Association

Well drained, very gently sloping to steep soils that formed in mixed loamy glacial till and sandy glacial outwash on moraines

Setting

Landform and position on the landform: Plane to slightly convex hilltops and convex side slopes on moraines
Slope range: 1 to 30 percent

Composition

Percent of survey area: 7
Extent of components in the association:
Snellman soils—60 percent
Sugarbush soils—15 percent
Minor soils—25 percent

Soil Properties and Qualities

Snellman
Drainage class: Well drained
Parent material: Glacial till
Surface texture: Sandy loam

Sugarbush
Drainage class: Well drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Minor Soils

- The very poorly drained Markey and Seelyeville soils in depressions
- The poorly drained Epoufette soils in swales and shallow depressions
- The moderately well drained Wykeham soils on nearly level hilltops and foot slopes
- The somewhat excessively drained Two Inlets soils on convex hilltops and side slopes

Use and Management

Major use: Woodland; about 95 percent of the association is deciduous forest (fig. 6).
Major management factors: Equipment limitation, plant competition, erosion hazard

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Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series.* Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Nebish loam, 2 to 8 percent slopes, is a phase of the Nebish series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Hamerly-Vallers complex is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Fordum, Fairdale, and Lamoure soils, frequently flooded, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. The Pits component of the Pits, gravel-Udipsamments complex is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

This publication includes suggested management practices that are intended to increase crop production, to reduce the hazard of erosion, and to overcome wetness limitations. Over a period of time, some or all of these conservation practices may or may not be in accordance with Federal, State, and local laws and agency rules and guides.

Soil Descriptions

33B—Barnes loam, 2 to 6 percent slopes

Composition

Barnes soil and similar soils: 85 to 98 percent
Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Hilltops and side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 500 acres

Typical Profile

0 to 9 inches—black loam
9 to 15 inches—dark brown loam
15 to 33 inches—yellowish brown, calcareous loam
33 to 60 inches—light yellowish brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Hamlet soils on slightly concave hilltops and foot slopes
- The moderately well drained Hamerly soils on slightly convex knolls
- The poorly drained Flom and Vallers soils in the lower concave areas
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of silt loam
- Soils that have a thinner dark surface layer
- Soils that have more clay in the subsoil
- Soils that have small seams of sand or gravel

Use and Management

Cropland

Major management factors: Water erosion

- All of the crops suited to the county can be grown in areas of this soil.
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion.

Pasture

Major management factors: Plant competition

- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2e
Windbreak suitability group: 3

36—Flom silty clay loam

Composition

Flom soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Drainageways and low flat areas on moraines
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 10 inches—black silty clay loam
10 to 15 inches—very dark grayish brown and dark grayish brown clay loam
15 to 20 inches—dark grayish brown, mottled clay loam
20 to 38 inches—grayish brown, mottled, calcareous loam
38 to 60 inches—light olive brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Hamerly and Hamlet soils in the slightly higher areas
- Very poorly drained soils in depressions

Similar soils:

- Soils that have small seams of sand or gravel
- Soils that have a surface layer of silt loam
- Soils that are calcareous at or near the surface
- Soils that have more clay in the subsoil

Use and Management

Woodland

Major management factors: Equipment limitations, windthrow hazard, plant competition

- Harvesting is limited to periods when the ground is frozen or dry.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Many trees may be blown down during periods of high winds and excessive wetness.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.

- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Wetness
- All of the crops suited to the county can be grown if adequate drainage is provided.
- Restricting fieldwork during wet periods minimizes surface compaction and helps to maintain tilth.

Pasture

Major management factors: Wetness, plant competition
- Grazing during wet periods results in compaction of the surface layer and restricts plant growth.
- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2w
Windbreak suitability group: 2, drained; 10, undrained

38B—Waukon loam, 2 to 8 percent slopes

Composition

Waukon soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Hilltops and side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

0 to 7 inches—very dark gray loam
7 to 9 inches—dark grayish brown loam
9 to 24 inches—dark brown clay loam
24 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Gonvick soils on slightly concave hilltops and foot slopes
- The poorly drained Flom soils in drainageways
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a surface layer of sandy loam
- Soils that have a thicker dark surface layer
- Soils that have small seams and pockets of sand or gravel
- Soils that have more clay in the subsoil

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition
- When the soil is wet, unsurfaced roads and landings are slippery and ruts form easily.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Water erosion
- All of the crops suited to the county can be grown in areas of this soil.
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion.

Pasture

Major management factors: Plant competition
- A planned grazing system should be used (fig. 7).
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2e
Woodland ordination symbol: 2L
Windbreak suitability group: 3

38C—Waukon loam, 8 to 15 percent slopes

Composition

Waukon soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 7 inches—very dark gray loam
7 to 8 inches—dark gray loam
8 to 13 inches—dark brown clay loam
13 to 23 inches—dark yellowish brown clay loam
23 to 60 inches—yellowish brown, calcareous loam

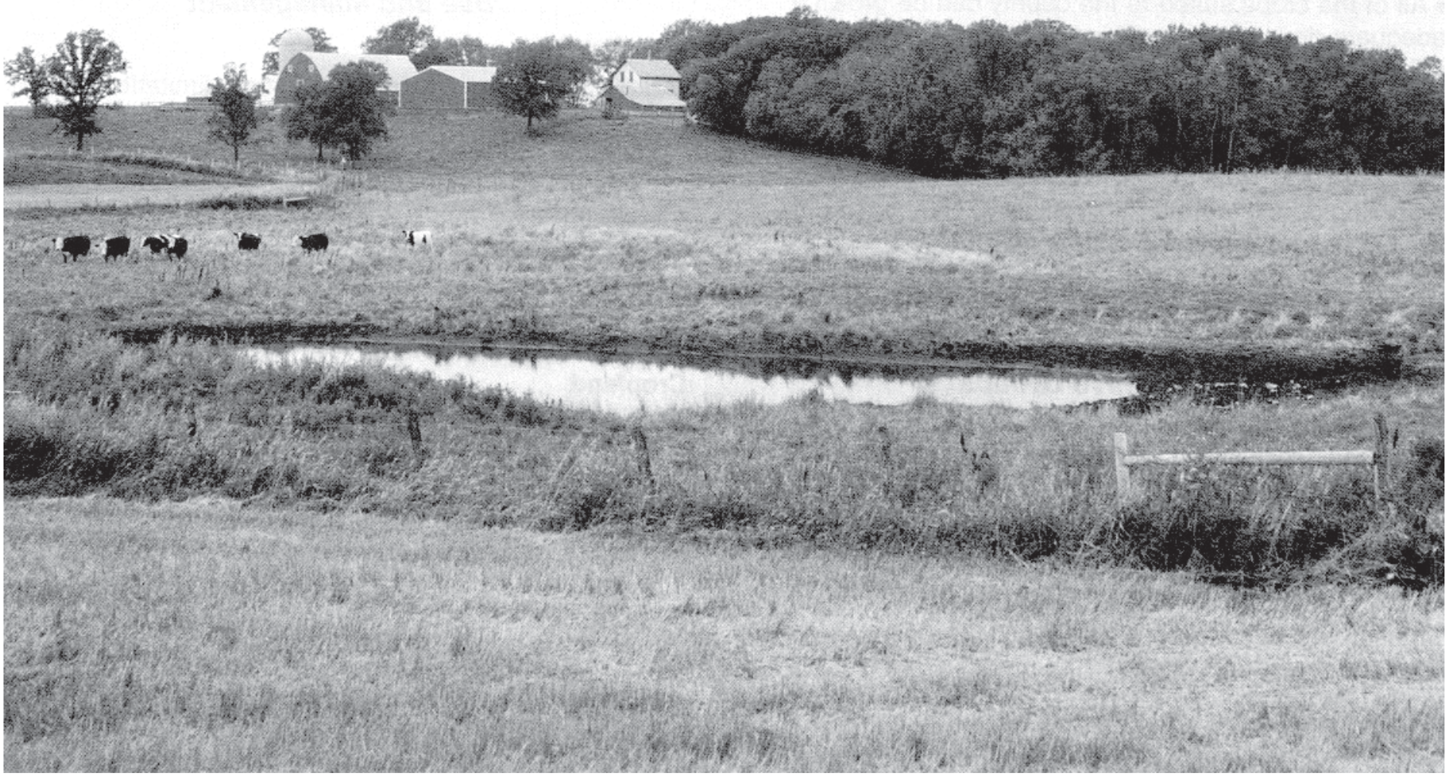

Figure 7.—This livestock watering pond in an area of Waukon loam, 2 to 8 percent slopes, helps to distribute grazing and is part of a planned grazing system.

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Gonvick soils on slightly concave hilltops and foot slopes
- The poorly drained Flom soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a thicker dark surface layer
- Soils that have small seams and pockets of sand or gravel
- Soils that have more clay in the subsoil
- Soils that have a surface layer of sandy loam

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- When the soil is wet, unsurfaced roads and landings are slippery and ruts form easily.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Water erosion

- All of the crops suited to the county can be grown in areas of this soil.

- Tilling on the contour or across the slope, chisel plowing, using grassed waterways, and including alfalfa and grasses in the rotation help to control erosion.

Pasture

Major management factors: Fertility

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 3e
Woodland ordination symbol: 2L
Windbreak suitability group: 3

38E—Waukon loam, 15 to 30 percent slopes

Composition

Waukon soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 50 acres

Typical Profile

0 to 4 inches—very dark gray loam
4 to 12 inches—dark brown clay loam
12 to 20 inches—brown clay loam
20 to 60 inches—yellowish brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Very rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Gonvick soils on slightly concave hilltops and foot slopes
- The poorly drained Flom soils in drainageways

Similar soils:

- Soils that have a thicker dark surface layer
- Soils that have small seams and pockets of sand or gravel
- Soils that have a surface layer of sandy loam
- Soils that have more clay in the subsoil

Use and Management

Woodland

Major management factors: Erosion hazard, equipment limitations, plant competition

- Careless use of wheeled and tracked equipment disturbs the protective layer of duff.
- Using conventional harvesting methods is difficult because of the slope.
- When the soil is wet, unsurfaced roads and landings are slippery and ruts form easily.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Slope

- This soil is not suited to crops because of the slope.

Pasture

Major management factors: Slope, fertility

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 6e
Woodland ordination symbol: 2R
Windbreak suitability group: 3

40B—Nebish loam, 2 to 8 percent slopes

Composition

Nebish soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Hilltops and side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

0 to 2 inches—very dark gray loam
2 to 5 inches—dark grayish brown loam
5 to 24 inches—dark brown clay loam
24 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High

Organic matter content: Moderately low
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Beltrami soils on slightly concave hilltops and foot slopes
- The poorly drained Talmoon soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have less clay and more sand
- Soils that have a thicker dark surface layer
- Soils that have more clay in the subsoil
- Soils that have small seams and pockets of sand or gravel

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- When the soil is wet, unsurfaced roads and landings are slippery and ruts form easily.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Water erosion

- All of the crops suited to the county can be grown in areas of this soil.
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion.

Pasture

Major management factors: Plant competition

- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2e
Woodland ordination symbol: 6L
Windbreak suitability group: 3

40C—Nebish loam, 8 to 15 percent slopes

Composition

Nebish soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 100

Typical Profile

0 to 3 inches—very dark gray loam
3 to 10 inches—pale brown sandy loam
10 to 17 inches—dark brown clay loam
17 to 23 inches—dark yellowish brown clay loam
23 to 60 inches—pale brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Beltrami soils on hilltops and foot slopes
- The poorly drained Talmoon soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have less clay and more sand
- Soils that have more clay in the subsoil
- Soils that have small seams and pockets of sand or gravel
- Soils that have a thicker dark surface layer

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- When the soil is wet, unsurfaced roads and landings are slippery and ruts form easily.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Water erosion

- All of the crops suited to the county can be grown in areas of this soil.
- Tilling on the contour or across the slope, maintaining crop residue on or near the surface, using grassed waterways, and including alfalfa and grasses in the rotation help to control erosion.

Pasture

Major management factors: Fertility
- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 3e
Woodland ordination symbol: 6L
Windbreak suitability group: 3

40E—Nebish loam, 15 to 30 percent slopes

Composition

Nebish soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 50 acres

Typical Profile

0 to 2 inches—very dark gray loam
2 to 6 inches—brown fine sandy loam
6 to 17 inches—dark brown loam
17 to 22 inches—dark yellowish brown clay loam
22 to 60 inches—yellowish brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Very rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Beltrami soils on hilltops and foot slopes
- The poorly drained Talmoon soils in drainageways

Similar soils:
- Soils that have more sand and less clay
- Soils that have a thicker dark surface layer
- Soils that have more clay in the subsoil
- Soils that have small seams and pockets of sand or gravel

Use and Management

Woodland

Major management factors: Erosion hazard, equipment limitations, plant competition
- Careless use of wheeled and tracked equipment disturbs the protective layer of duff.
- Using conventional harvesting methods is difficult because of the slope.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Slope
- This soil is not suited to crops because of the slope.

Pasture

Major management factors: Slope, fertility
- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 6e
Woodland ordination symbol: 6R
Windbreak suitability group: 3

59—Grimstad sandy loam

Composition

Grimstad soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Plane and slightly convex hilltops and foot slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 50 acres

Typical Profile

0 to 8 inches—black, calcareous sandy loam
8 to 13 inches—dark grayish brown, calcareous fine sandy loam
13 to 21 inches—dark grayish brown, calcareous loamy fine sand
21 to 32 inches—light olive brown, mottled, calcareous loamy fine sand
32 to 39 inches—grayish brown, mottled, calcareous loamy fine sand
39 to 60 inches—grayish brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderately rapid in the upper part, rapid in

the next part, moderate in the lower part
Available water capacity: Moderate
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: 2.5 to 4.0 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Foldahl soils in the slightly higher convex areas
- The poorly drained Rockwell soils in the lower concave areas

Similar soils:
- Soils that have loamy glacial till at a depth of less than 20 inches
- Soils that have numerous cobbles at the surface

Use and Management

Cropland

Major management factors: Soil blowing, high pH
- All of the crops suited to the county can be grown in areas of this soil.
- Crop varieties that are tolerant of the high pH level should be selected.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.

Pasture

Major management factors: Plant competition
- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2s
Windbreak suitability group: 1K

63—Rockwell loam

Composition

Rockwell soil and similar soils: 85 to 98 percent
Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Drainageways and broad flat areas on moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 9 inches—black, calcareous loam
9 to 17 inches—dark gray, calcareous loam
17 to 27 inches—grayish brown, mottled, calcareous fine sandy loam
27 to 34 inches—light brownish gray, mottled, calcareous sand
34 to 60 inches—olive gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part, rapid in the next part, moderately slow or moderate in the lower part
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
- The poorly drained Vallers soils, which formed in glacial till; in landscape positions similar to those of the Rockwell soil
- The poorly drained Marysland soils, which have sandy outwash material at a depth of 20 to 40 inches
- The somewhat poorly drained Grimstad soils in the slightly higher areas

Similar soils:
- Soils that have a surface layer of silt loam

Use and Management

Cropland

Major management factors: Wetness, soil blowing, high pH
- Most crops suited to the county can be grown if adequate drainage is provided.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Plant competition, wetness
- A planned grazing system should be used.
- Grazing during wet periods causes compaction of the surface layer and restricts plant growth.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2w
Windbreak suitability group: 2K

121—Wykeham fine sandy loam

Composition

Wykeham soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Plane and slightly convex hilltops and foot slopes on moraines
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 6 inches—very dark gray fine sandy loam
6 to 10 inches—grayish brown loamy fine sand
10 to 20 inches—dark brown sandy loam
20 to 30 inches—dark yellowish brown, mottled sandy clay loam
30 to 60 inches—yellowish brown, mottled, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: Moderate
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to the water table: 2.5 to 4.0 feet

Inclusions

Contrasting inclusions:

- The well drained Snellman soils in the higher convex areas
- The poorly drained Egglake soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of loam
- Soils that have small seams and pockets of sand or gravel
- Soils that have less clay and more sand

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- When the soil is wet, unsurfaced roads and landings are slippery and ruts form easily.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.

Cropland

Major management factors: Soil blowing

- All of the crops suited to the county can be grown in areas of this soil.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.

Pasture

Major management factors: Plant competition

- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 1
Woodland ordination symbol: 6L
Windbreak suitability group: 1

125—Beltrami loam

Composition

Beltrami soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Plane and slightly convex hilltops and foot slopes on moraines
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 4 inches—very dark gray loam
4 to 9 inches—grayish brown loam
9 to 21 inches—yellowish brown, mottled clay loam
21 to 32 inches—brown, mottled clay loam
32 to 36 inches—light olive brown, mottled, calcareous clay loam
36 to 60 inches—light yellowish brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Slow or medium
Depth to the water table: 2 to 4 feet

Inclusions

Contrasting inclusions:

- The well drained Nebish soils on side slopes
- The poorly drained Talmoon soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have more sand and less clay
- Soils that have small seams and pockets of sand or gravel

- Soils that have more clay in the subsoil

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- Using heavy equipment and conventional harvesting methods during wet periods can result in compaction of the soil.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

- There are no major limitations affecting the production of crops. All of the crops suited to the county can be grown in areas of this soil.
- A system of conservation tillage helps to maintain good tilth and the content of organic matter.

Pasture

Major management factors: Plant competition

- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 1
Woodland ordination symbol: 7L
Windbreak suitability group: 1

127B—Sverdrup sandy loam, 1 to 6 percent slopes

Composition

Sverdrup soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Hilltops and side slopes on moraines and outwash plains
Shape of areas: Irregular
Size of areas: 3 to 80 acres

Typical Profile

0 to 10 inches—black sandy loam
10 to 16 inches—very dark grayish brown sandy loam
16 to 27 inches—dark yellowish brown loamy sand
27 to 40 inches—light yellowish brown, calcareous fine sand
40 to 60 inches—light yellowish brown, calcareous sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Available water capacity: Low
Organic matter content: Moderate
Surface runoff: Moderate
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The poorly drained Marysland and Rockwell soils in the lower concave areas

Similar soils:

- Soils that have small seams of gravel
- Soils that have a substratum of loamy glacial till
- Soils that have a surface layer of silt loam

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing

- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion and conserve moisture.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing and also collect snow for moisture.

Pasture

Major management factors: Available water capacity, fertility

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 3e
Windbreak suitability group: 6G

180—Gonvick loam

Composition

Gonvick soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Plane and slightly convex hilltops and foot slopes on moraines
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 3 to 40 acres

Typical Profile

0 to 10 inches—black loam

10 to 17 inches—dark grayish brown clay loam
17 to 25 inches—olive brown, mottled clay loam
25 to 60 inches—light olive brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to the water table: 2.5 to 4.0 feet

Inclusions

Contrasting inclusions:

- The poorly drained Flom soils in drainageways
- The well drained Waukon soils on side slopes

Similar soils:

- Soils that have small seams and pockets of sand or gravel
- Soils that have more clay in the subsoil
- Soils that have a thinner dark surface layer

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- Using heavy equipment and conventional harvesting methods during wet periods can result in compaction of the soil.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

- There are no major limitations affecting the production of crops. All of the crops suited to the county can be grown in areas of this soil.
- A system of conservation tillage helps to maintain good tilth and the content of organic matter.

Pasture

Major management factors: Plant competition

- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 1
Woodland ordination symbol: 2A
Windbreak suitability group: 1

191—Epoufette sandy loam

Composition

Epoufette soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Drainageways and shallow depressions on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 9 inches—black sandy loam
9 to 27 inches—dark grayish brown, mottled sand
27 to 35 inches—dark grayish brown, mottled sandy loam
35 to 60 inches—grayish brown, mottled, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part, very rapid in the lower part
Available water capacity: Low
Organic matter content: High
Surface runoff: Very slow
Depth to the water table: 0.5 foot to 2.0 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Karlstad soils in the slightly higher areas
- Very poorly drained soils in depressions

Similar soils:

- Soils that have less sand
- Soils that are calcareous at or near the surface
- Soils that have a thicker dark surface layer

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow hazard, plant competition

- Harvesting is limited to periods when the ground is frozen or dry.
- Seasonal wetness causes a moderate rate of seedling mortality.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Many trees may be blown down during periods of high winds and excessive wetness.
- If openings are made in the canopy, invading plants

can prevent natural or artificial regeneration of desired species.

- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Wetness, soil blowing

- Most of the crops suited to the county can be grown if adequate drainage is provided. Providing drainage is difficult, however, because most areas have poor outlets.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.

Pasture

Major management factors: Wetness

- Grazing during wet periods results in compaction of the surface layer and restricts plant growth.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 4w
Woodland ordination symbol: 2W
Windbreak suitability group: 2

205—Karlstad sandy loam

Composition

Karlstad soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Plane and slightly convex hilltops and foot slopes on outwash plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 3 to 50 acres

Typical Profile

0 to 2 inches—very dark gray sandy loam
2 to 11 inches—dark grayish brown, mottled loamy sand
11 to 20 inches—dark brown, mottled sandy loam
20 to 25 inches—dark brown, mottled gravelly sandy loam
25 to 60 inches—yellowish brown, mottled, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Available water capacity: Low
Organic matter content: Moderately low or moderate
Surface runoff: Slow
Depth to the water table: 2.5 to 6.0 feet

Inclusions

Contrasting inclusions:

- The well drained Sugarbush soils on side slopes
- The poorly drained Epoufette soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of loamy sand
- Soils that have less clay in the subsoil

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized.
- If large openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Available water capacity, soil blowing

- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion and conserve moisture.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing and also collect snow for moisture.

Pasture

Major management factors: Plant competition, available water capacity

- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 4s
Woodland ordination symbol: 5L
Windbreak suitability group: 1

236—Vallers silty clay loam

Composition

Vallers soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Drainageways, edges of depressions, and low flat areas on moraines
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 9 inches—black, calcareous silty clay loam
9 to 19 inches—very dark gray, mottled, calcareous silty clay loam
19 to 31 inches—grayish brown, mottled, calcareous silty clay loam
31 to 60 inches—grayish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to the water table: 1.0 to 2.5 feet

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Hamerly soils on the slightly higher convex knolls
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of silt loam
- Soils that have small seams and pockets of sand or gravel
- Soils that are noncalcareous at or near the surface

Use and Management

Cropland

Major management factors: Wetness, soil blowing, high pH

- All of the crops suited to the county can be grown if adequate drainage is provided.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.
- Restricting fieldwork during wet periods minimizes surface compaction and helps to maintain tilth.

Pasture

Major management factors: Wetness, plant competition

- Grazing during wet periods results in compaction of the surface layer and restricts plant growth.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2w
Windbreak suitability group: 2K, drained; 10, undrained

267B—Snellman sandy loam, 2 to 8 percent slopes

Composition

Snellman soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Hilltops and side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

0 to 3 inches—very dark gray sandy loam
3 to 7 inches—yellowish brown sandy loam
7 to 12 inches—dark yellowish brown sandy loam
12 to 23 inches—dark yellowish brown sandy clay loam
23 to 60 inches—light yellowish brown, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate or moderately rapid in the upper part, moderate in the lower part
Available water capacity: Moderate
Organic matter content: Moderately low or moderate
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Wykeham soils on hilltops and foot slopes
- The poorly drained Egglake soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of fine sandy loam
- Soils that have more clay in the substratum
- Soils that have numerous cobble- to boulder-sized fragments throughout the profile

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- When the soil is wet, unsurfaced roads and landings are slippery and ruts form easily.

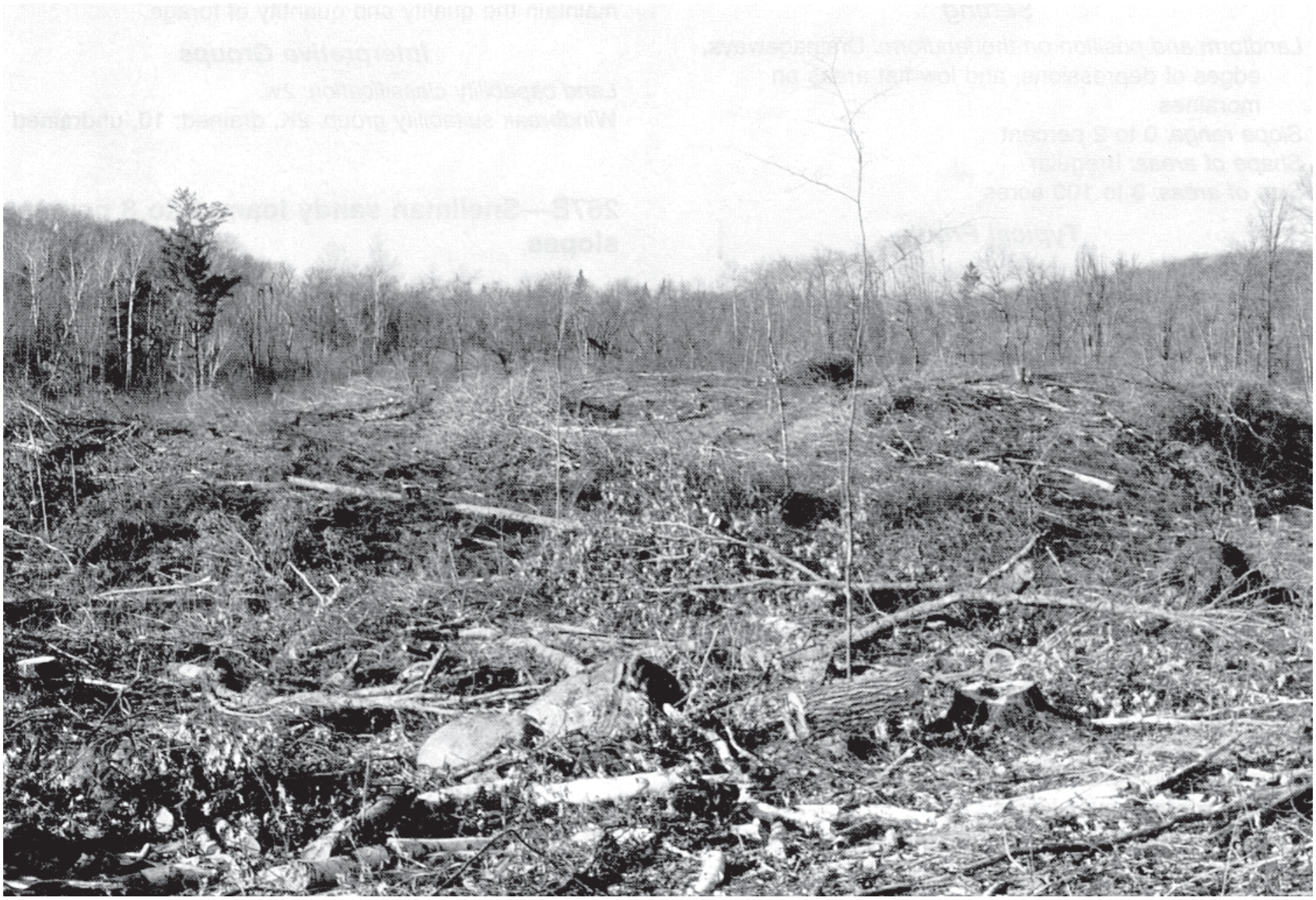

Figure 8.—A clearcut area of Snellman sandy loam, 2 to 8 percent slopes. Openings in the canopy encourage the growth of undesirable species.

- If large openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species (fig. 8).
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Water erosion, soil blowing

- All of the crops suited to the county can be grown in areas of this soil.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of erosion.

Pasture

Major management factors: Fertility, plant competition

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2e
Woodland ordination symbol: 6L
Windbreak suitability group: 3

267C—Snellman sandy loam, 8 to 15 percent slopes

Composition

Snellman soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

0 to 3 inches—very dark gray sandy loam
3 to 15 inches—pale brown loamy sand
15 to 19 inches—yellowish brown and pale brown sandy loam
19 to 28 inches—yellowish brown sandy clay loam
28 to 60 inches—light yellowish brown, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate or moderately rapid in the upper part, moderate in the lower part
Available water capacity: Moderate
Organic matter content: Moderately low or moderate
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Wykeham soils on hilltops and foot slopes
- The poorly drained Egglake soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of fine sandy loam
- Soils that have more clay in the substratum
- Soils that have numerous cobble- to boulder-sized fragments throughout the profile

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- When the soil is wet, unsurfaced roads and landings are slippery and ruts form easily.
- If large openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Water erosion, soil blowing

- All of the crops suited to the county can be grown in areas of this soil.
- Tilling on the contour or across the slope, chisel plowing, using grassed waterways, and including alfalfa and grasses in the rotation help to control erosion.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.

Pasture

Major management factors: Fertility

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 3e
Woodland ordination symbol: 6L
Windbreak suitability group: 3

267E—Snellman sandy loam, 15 to 30 percent slopes

Composition

Snellman soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

0 to 3 inches—very dark gray sandy loam
3 to 8 inches—light yellowish brown fine sandy loam
8 to 18 inches—yellowish brown loam
18 to 29 inches—dark yellowish brown loam
29 to 60 inches—light yellowish brown, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate or moderately rapid in the upper part, moderate in the lower part
Available water capacity: Moderate
Organic matter content: Moderately low or moderate
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Wykeham soils on hilltops and foot slopes
- The poorly drained Egglake soils in drainageways

Similar soils:

- Soils that have a surface layer of fine sandy loam

- Soils that have more clay in the substratum
- Soils that have numerous cobble- to boulder-sized fragments throughout the profile

Use and Management

Woodland

Major management factors: Erosion hazard, equipment limitations, plant competition

- Careless use of wheeled and tracked equipment disturbs the protective layer of duff.
- Seeding landings, logging areas, and skid roads after the trees are logged helps to establish a protective plant cover.
- Using conventional harvesting methods is difficult because of the slope.
- If large openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Slope

- This soil is generally not suited to crops because of the slope.

Pasture

Major management factors: Slope, fertility

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 6e
Woodland ordination symbol: 6R
Windbreak suitability group: 3

290B—Rothsay silt loam, 1 to 6 percent slopes

Composition

Rothsay soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Hilltops and side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 60 acres

Typical Profile

0 to 9 inches—black silt loam
9 to 13 inches—very dark gray silt loam
13 to 23 inches—brown silt loam
23 to 60 inches—light yellowish brown, calcareous silt loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: Very high
Organic matter content: Moderate or high
Surface runoff: Slow or medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- Poorly drained soils in drainageways
- Soils that are underlain by glacial till at a depth of less than 40 inches

Similar soils:

- Soils that have carbonates at or near the surface
- Soils that have more sand

Use and Management

Cropland

Major management factors: Water erosion

- All of the crops suited to the county can be grown in areas of this soil.
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion.

Pasture

Major management factors: Plant competition

- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2e
Windbreak suitability group: 3

296—Fram loam

Composition

Fram soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Plane and slightly convex knolls on moraines
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

0 to 12 inches—black, calcareous loam

12 to 19 inches—dark grayish brown, calcareous fine sandy loam
19 to 60 inches—light olive brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High or very high
Surface runoff: Slow
Depth to the water table: 2 to 6 feet

Inclusions

Contrasting inclusions:

- The poorly drained Hedman soils in drainageways and low flat areas
- The well drained Heimdal soils on side slopes
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of sandy loam or silt loam
- Soils that have small seams and pockets of sand or gravel

Use and Management

Cropland

Major management factors: Water erosion, soil blowing, high pH

- All of the crops suited to the county can be grown in areas of this soil.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Plant competition

- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2e
Windbreak suitability group: 1K

332B—Sugarbush sandy loam, 1 to 8 percent slopes

Composition

Sugarbush soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Hilltops and side slopes on outwash plains and valley trains
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

0 to 3 inches—black sandy loam
3 to 9 inches—dark brown loamy sand
9 to 24 inches—dark yellowish brown sandy loam
24 to 60 inches—brown, calcareous gravelly coarse sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid or rapid in the upper part, moderately rapid in the next part, very rapid in the lower part
Available water capacity: Low
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat excessively drained Two Inlets soils on side slopes
- The moderately well drained Karlstad soils on concave hilltops and foot slopes
- The poorly drained Epoufette soils in drainageways

Similar soils:

- Soils that have a surface layer of loamy sand
- Soils that have more clay in the subsoil
- Soils that have less clay in the subsoil
- Soils that have more gravel in the substratum
- Soils that have numerous cobble- to boulder-sized fragments throughout the profile

Use and Management

Woodland

Major management factors: Plant competition

- If large openings are made in the canopy, invading plants can delay the natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Available water capacity, water erosion, soil blowing

- All of the crops suited to the county can be grown in areas of this soil.
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion.

- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing and also collect snow for moisture.

Pasture

Major management factors: Fertility
- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 3s
Woodland ordination symbol: 6A
Windbreak suitability group: 6G

335—Urness mucky silt loam

Composition

Urness soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Shallow lake basins
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 3 to 160 acres

Typical Profile

0 to 12 inches—black, calcareous mucky silt loam
12 to 22 inches—very dark gray, calcareous mucky silt loam
22 to 33 inches—dark gray, calcareous mucky silt loam
33 to 60 inches—very dark gray, calcareous mucky silt loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately slow
Available water capacity: High
Organic matter content: Very high
Surface runoff: Ponded
Seasonal high water table: 2 feet above to 1 foot below the surface

Inclusions

Contrasting inclusions:
- The poorly drained Vallers soils on the edges of depressions
- The very poorly drained, noncalcareous Quam soils in depressions

Similar soils:
- Soils that have layers of peat
- Soils that have thin layers of mineral materials

Use and Management

Cropland

Major management factors: Wetness, high pH, soil blowing
- Most crops suited to the county can be grown if adequate drainage is provided. Providing drainage is difficult, however, because most areas have poor outlets and are seasonally flooded.
- Crop varieties that are tolerant of the high pH level should be selected.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.

Pasture

Major management factors: Wetness, ponding
- Hay and pasture plants that are tolerant of ponding and seasonal wetness, such as reed canarygrass, should be seeded.

Interpretive Groups

Land capability classification: 3w
Windbreak suitability group: 10

344—Quam silty clay loam

Composition

Quam soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Depressions on moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 3 to 40 acres

Typical Profile

0 to 44 inches—black silty clay loam
44 to 56 inches—dark grayish brown, mottled clay loam
56 to 60 inches—olive gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High or very high
Surface runoff: Very slow or ponded
Seasonal high water table: 2 feet above to 1 foot below the surface

Inclusions

Contrasting inclusions:
- The very poorly drained, calcareous Urness soils in the lowest parts of depressions
- The poorly drained Vallers soils on the edges of depressions

Similar soils:
- Soils that have a surface layer of clay loam
- Soils that have a surface layer of muck

Use and Management

Cropland

Major management factors: Wetness
- Most crops suited to the county can be grown if adequate drainage is provided.
- Restricting fieldwork during wet periods minimizes surface compaction and helps to maintain tilth.

Pasture

Major management factors: Wetness, ponding
- Hay and pasture plants that are tolerant of periodic ponding and seasonal wetness, such as reed canarygrass, should be seeded.

Interpretive Groups

Land capability classification: 3w
Windbreak suitability group: 2W, drained; 10, undrained

346—Talmoon loam

Composition

Talmoon soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Drainageways and low flat areas on moraines
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 5 inches—black loam
5 to 13 inches—dark gray, mottled loam
13 to 25 inches—olive gray, mottled clay loam
25 to 60 inches—olive gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate in the upper part, moderately slow in the lower part
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Beltrami soils on hilltops and foot slopes
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a surface layer of silt loam
- Soils that have more sand in the substratum

Use and Management

Woodland

Major management factors: Equipment limitations, windthrow hazard, plant competition
- Harvesting is limited to periods when the ground is frozen or dry.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Many trees may be blown down during periods of high winds and excessive wetness.
- If large openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Wetness
- All of the crops suited to the county can be grown if adequate drainage is provided.
- Restricting fieldwork during wet periods minimizes surface compaction and helps to maintain tilth.

Pasture

Major management factors: Wetness
- Grazing during wet periods results in compaction of the surface layer and restricts plant growth.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2w
Woodland ordination symbol: 6W
Windbreak suitability group: 2, drained; 10, undrained

352B—Heimdal loam, 2 to 6 percent slopes

Composition

Heimdal soil and similar soils: 85 to 98 percent
Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Hilltops and side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 500 acres

Typical Profile

0 to 8 inches—black loam
8 to 17 inches—brown loam
17 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The well drained Esmond soils on convex side slopes
- The moderately well drained, calcareous Fram soils on slightly convex knolls
- The poorly drained Hedman soils in drainageways and low flat areas
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a thinner dark surface layer
- Soils that have more clay and less sand

Use and Management

Cropland

Major management factors: Water erosion
- All of the crops suited to the county can be grown in areas of this soil.
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion.

Pasture

Major management factors: Plant competition
- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2e
Windbreak suitability group: 3

426—Foldahl sandy loam

Composition

Foldahl soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Plane and slightly convex hilltops and foot slopes on glacial lake plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 3 to 50 acres

Typical Profile

0 to 8 inches—black sandy loam
8 to 15 inches—very dark grayish brown loamy sand
15 to 22 inches—dark grayish brown loamy sand
22 to 30 inches—yellowish brown, mottled, calcareous fine sand
30 to 60 inches—light olive brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Rapid in the upper part, moderately slow or moderate in the lower part
Available water capacity: Moderate
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to the water table: 2.5 to 4.0 feet

Inclusions

Contrasting inclusions:
- The poorly drained Rockwell soils in the lower concave areas
- The moderately well drained Grimstad soils in the slightly lower plane areas
- The well drained Sverdrup soils, which have sandy outwash material at a depth of more than 40 inches; on convex slopes

Similar soils:
- Soils that have a surface layer of loam
- Soils that have small seams or pockets of gravel

Use and Management

Cropland

Major management factors: Soil blowing
- All of the crops suited to the county can be grown in areas of this soil.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.

Pasture

Major management factors: Plant competition
- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2s
Windbreak suitability group: 1

494B—Darnen loam, 2 to 6 percent slopes

Composition

Darnen soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Foot slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 20 acres

Typical Profile

0 to 28 inches—black loam
28 to 38 inches—very dark grayish brown loam
38 to 47 inches—very dark grayish brown and dark grayish brown, calcareous loam
47 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Barnes soils on side slopes
- The poorly drained Flom soils in drainageways

Similar soils:

- Soils that have a calcareous surface layer
- Soils that have a thinner dark surface layer
- Soils that have small seams and pockets of sand or gravel

Use and Management

Cropland

Major management factors: Water erosion

- All of the crops suited to the county can be grown in areas of this soil.
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion.

Pasture

Major management factors: Plant competition

- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2e
Windbreak suitability group: 3

540—Seelyeville muck

Composition

Seelyeville soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Depressions on moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 44 inches—black muck
44 to 54 inches—dark brown muck
54 to 60 inches—very dark brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 2 feet above to 2 feet below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained Cathro soils, which have layers of muck less than 51 inches thick over glacial till
- The very poorly drained Haslie soils, which have layers of muck less than 51 inches thick over limnic material
- The very poorly drained Markey soils, which have layers of muck less than 51 inches thick over a sandy substratum
- Poorly drained and very poorly drained, mineral soils at the margins of the map unit

Similar soils:

- Soils that have thin layers of hemic material

Use and Management

Woodland

Major management factors: Wetness

- Because of wetness and severe seedling mortality, trees are not managed for commercial purposes on this soil.

Cropland

Major management factors: Wetness, soil blowing

- Most crops suited to the county can be grown if adequate drainage is provided. Providing drainage is difficult, however, because most areas have poor outlets and are seasonally ponded.
- Maintaining crop residue on the surface, using

conservation tillage, or growing a cover crop helps to control soil blowing.

Pasture

Major management factors: Wetness, ponding

- Grasses that are tolerant of seasonal wetness and periodic ponding, such as reed canarygrass, should be seeded.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 4w, drained; 6w, undrained
Windbreak suitability group: 2(O), drained; 10, undrained

543—Markey muck

Composition

Markey soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Depressions on outwash plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 3 to 150 acres

Typical Profile

0 to 13 inches—very dark brown muck
13 to 19 inches—very dark grayish brown muck
19 to 28 inches—very dark brown muck
28 to 46 inches—grayish brown, calcareous fine sand
46 to 60 inches—dark grayish brown, calcareous sand

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part, rapid in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded or very slow
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained Hamre soils, which have a layer of muck less than 16 inches thick
- The very poorly drained Seelyeville soils, which have a layer of muck more than 51 inches thick
- Poorly drained and very poorly drained, mineral soils at the margins of the map unit

Similar soils:

- Soils that have loam below the layers of muck
- Soils that have limnic material below the layers of muck

Use and Management

Woodland

Major management factors: Wetness

- Because of wetness and severe seedling mortality, trees are not managed for commercial purposes on this soil.

Cropland

Major management factors: Wetness, soil blowing

- Most crops suited to the county can be grown if adequate drainage is provided. Providing drainage is difficult, however, because most areas have poor outlets and are seasonally ponded.
- Maintaining crop residue on the surface, using conservation tillage, or growing a cover crop helps to control soil blowing.

Pasture

Major management factors: Wetness, ponding

- Grasses that are tolerant of seasonal wetness and periodic ponding, such as reed canarygrass, should be seeded.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 4w, drained; 6w, undrained
Windbreak suitability group: 2(O), drained; 10, undrained

544—Cathro muck

Composition

Cathro soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Depressions on moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 24 inches—black muck
24 to 36 inches—light brownish gray, mottled, calcareous loam
36 to 60 inches—gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part, moderately slow or moderate in the lower part

Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained Hamre soils, which have layers of muck less than 16 inches thick
- The very poorly drained Seelyeville soils, which have layers of muck more than 51 inches thick
- Poorly drained and very poorly drained, mineral soils at the margins of the map unit

Similar soils:

- Soils that have sand below the layers of muck
- Soils that have limnic material below the layers of muck

Use and Management

Woodland

Major management factors: Wetness

- Because of wetness and severe seedling mortality, trees are not managed for commercial purposes on this soil.

Cropland

Major management factors: Wetness, soil blowing

- Most crops suited to the county can be grown if adequate drainage is provided.
- Maintaining crop residue on the surface, using conservation tillage, or growing a cover crop helps to control soil blowing.

Pasture

Major management factors: Wetness, ponding

- Grasses that are tolerant of seasonal wetness and periodic ponding should be seeded.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 4w, drained; 6w, undrained
Woodland ordination symbol: 3W
Windbreak suitability group: 2(O), drained; 10, undrained

718B—Naytahwaush loam, 2 to 8 percent slopes

Composition

Naytahwaush soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Hilltops and side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 500 acres

Typical Profile

0 to 4 inches—black loam
4 to 8 inches—very dark grayish brown loam
8 to 18 inches—dark brown clay
18 to 23 inches—dark yellowish brown silty clay loam
23 to 32 inches—yellowish brown, calcareous silty clay loam
32 to 60 inches—light olive brown, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately slow or moderate in the upper part, slow in the next part, moderately slow in the lower part
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Mahkonce soils on hilltops and foot slopes
- The poorly drained Auganaush soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have less clay in the subsoil
- Soils that have a thinner dark surface layer
- Soils that have small seams and pockets of sand or gravel

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, plant competition

- Using wheeled and tracked equipment on wet soil produces ruts, compacts the soil, and damages the roots of trees.
- Harvesting is limited to periods when the ground is frozen or dry.
- Because of the potential for frost action, special construction and maintenance of logging roads are needed.
- The clayey texture results in a high rate of seedling mortality. The seedling mortality rate can be reduced by careful planting of adapted, vigorous nursery stock.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Water erosion, high clay content

- All of the crops suited to the county can be grown in areas of this soil.
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion.
- Restricting fieldwork during wet periods minimizes surface compaction and helps to maintain tilth.

Pasture

Major management factors: Clay content, plant competition

- A planned grazing system should be used.
- Restricting grazing during wet periods helps to prevent compaction of the surface layer.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2e
Woodland ordination symbol: 6D
Windbreak suitability group: 4L

718C—Naytahwaush loam, 8 to 15 percent slopes

Composition

Naytahwaush soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

0 to 5 inches—very dark brown loam
5 to 8 inches—dark grayish brown loam
8 to 16 inches—dark brown clay
16 to 22 inches—dark brown clay loam
22 to 60 inches—brown, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately slow or moderate in the upper part, slow in the next part, moderately slow in the lower part
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Mahkonce soils on hilltops and foot slopes
- The poorly drained Auganaush soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have less clay in the subsoil
- Soils that have a thinner dark surface layer
- Soils that have small seams and pockets of sand or gravel

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow hazard, plant competition

- Using wheeled and tracked equipment on wet soil produces ruts, compacts the soil, and damages the roots of trees.
- Harvesting is limited to periods when the ground is frozen or dry.
- Because of the potential for frost action, special construction and maintenance of logging roads are needed.
- The clayey texture results in a high rate of seedling mortality. The seedling mortality rate can be reduced by careful planting of adapted, vigorous nursery stock.
- Using harvesting methods that do not leave the remaining trees isolated or widely spaced reduces the hazard of windthrow.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Water erosion, high clay content

- All of the crops suited to the county can be grown in areas of this soil.
- Tilling on the contour or across the slope, chisel plowing, using grassed waterways, and including alfalfa and grasses in the rotation help to control erosion.
- Restricting fieldwork during wet periods minimizes surface compaction and helps to maintain tilth.

Pasture

Major management factors: Clay content, plant competition, water erosion

- A planned grazing system should be used.
- Restricting grazing during wet periods helps to prevent compaction of the surface layer.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.
- Seeding and mulching slopes and disturbed areas reduce the hazard of erosion.

Interpretive Groups

Land capability classification: 3e
Woodland ordination symbol: 6D
Windbreak suitability group: 4L

718E—Naytahwaush loam, 15 to 30 percent slopes

Composition

Naytahwaush soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 3 inches—very dark brown loam
3 to 6 inches—very dark gray loam
6 to 20 inches—dark brown clay
20 to 46 inches—dark yellowish brown, calcareous clay loam
46 to 60 inches—yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately slow or moderate in the upper part, slow in the next part, moderately slow in the lower part
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Very rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Mahkonce soils on hilltops and foot slopes
- The poorly drained Auganaush soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have less clay in the subsoil
- Soils that have a thinner dark surface layer
- Soils that have small seams and pockets of sand or gravel

Use and Management

Woodland

Major management factors: Erosion hazard, equipment limitations, plant competition

- Using conventional harvesting methods is difficult because of the slope.
- Using wheeled and tracked equipment on wet soil produces ruts, compacts the soil, and damages the roots of trees.
- Harvesting is limited to periods when the ground is frozen or dry.
- Because of the potential for frost action, special construction and maintenance of logging roads are needed.
- The clayey texture results in a high rate of seedling mortality. The seedling mortality rate can be reduced by careful planting of adapted, vigorous nursery stock.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Slope

- This soil is generally not suited to crops because of the slope.

Pasture

Major management factors: Slope, clay content, water erosion

- A planned grazing system should be used.
- Restricting grazing during wet periods helps to prevent compaction of the surface layer.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.
- Seeding and mulching slopes and disturbed areas reduce the hazard of erosion.

Interpretive Groups

Land capability classification: 6e
Woodland ordination symbol: 6R
Windbreak suitability group: 4L

737—Mahkonce loam

Composition

Mahkonce soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Plane and slightly convex hilltops and foot slopes on moraines
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 3 to 80 acres

Typical Profile

0 to 4 inches—black loam
4 to 10 inches—grayish brown loam
10 to 15 inches—dark grayish brown, mottled clay
15 to 19 inches—olive brown, mottled clay

19 to 26 inches—light olive brown, mottled clay loam
26 to 60 inches—light olive brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately slow in the upper part, slow in the next part, moderately slow in the lower part
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to the water table: 2 to 4 feet

Inclusions

Contrasting inclusions:

- The poorly drained Auganaush soils in drainageways
- The well drained Naytahwaush soils on hilltops and side slopes
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a thicker dark surface layer
- Soils that have less clay in the subsoil
- Soils that have a surface layer of silt loam
- Soils that have small seams and pockets of sand or gravel

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- Using wheeled and tracked equipment on wet soil produces ruts, compacts the soil, and damages the roots of trees.
- Harvesting is limited to periods when the ground is frozen or dry.
- Because of the potential for frost action, special construction and maintenance of logging roads are needed.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: High clay content

- All of the crops suited to the county can be grown in areas of this soil.
- Restricting fieldwork during wet periods minimizes surface compaction and helps to maintain tilth.
- Growing alfalfa, sweet clover, and other deep-rooted legumes opens channels in the clayey subsoil and helps to maintain drainage.

Pasture

Major management factors: Plant competition, clay content

- A planned grazing system should be used.
- Restricting grazing during wet periods helps to prevent compaction of the surface layer.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2s
Woodland ordination symbol: 2C
Windbreak suitability group: 4L

746—Haslie muck

Composition

Haslie soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Depressions on moraines and outwash plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 42 inches—black muck
42 to 60 inches—dark gray, calcareous coprogenous earth

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid in the upper part, slow in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained Hamre soils, which have layers of muck less than 16 inches thick
- The very poorly drained Seelyeville soils, which have layers of muck more than 51 inches thick
- Poorly drained and very poorly drained, mineral soils at the margins of the map unit

Similar soils:

- Soils that have sand below the layers of muck
- Soils that have loam below the layers of muck

Use and Management

Woodland

Major management factors: Wetness

- Because of wetness and severe seedling mortality, trees are not managed for commercial purposes on this soil.

Cropland

Major management factors: Wetness, soil blowing
- Most crops suited to the county can be grown if adequate drainage is provided. Providing drainage is difficult, however, because most areas have poor outlets and are seasonally ponded.
- Maintaining crop residue on the surface, using conservation tillage, or growing a cover crop helps to control soil blowing.

Pasture

Major management factors: Wetness, plant competition
- Grasses that are tolerant of seasonal wetness and periodic ponding, such as reed canarygrass, should be seeded.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 4w, drained; 6w, undrained
Woodland ordination symbol: 2W
Windbreak suitability group: 2(O), drained; 10, undrained

748—Hamlet loam

Composition

Hamlet soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Plane and slightly convex hilltops and foot slopes on moraines
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 3 to 40 acres

Typical Profile

0 to 12 inches—black loam
12 to 17 inches—dark grayish brown loam
17 to 20 inches—olive brown, mottled loam
20 to 35 inches—light yellowish brown, mottled, calcareous loam
35 to 60 inches—light olive brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Depth to the water table: 3 to 5 feet

Inclusions

Contrasting inclusions:
- The poorly drained Flom soils in drainageways
- The well drained Barnes soils on side slopes

Similar soils:
- Soils that have a thicker dark surface layer
- Soils that are calcareous at or near the surface
- Soils that have small seams and pockets of sand or gravel

Use and Management

Cropland

- There are no major limitations affecting the production of crops. All of the crops suited to the county can be grown in areas of this soil.
- A system of conservation tillage helps to maintain good tilth and the content of organic matter.

Pasture

Major management factors: Plant competition
- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 1
Windbreak suitability group: 1

749—Colvin silt loam, occasionally flooded

Composition

Colvin soil and similar soils: 85 to 98 percent
Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Plane and slightly concave areas on outwash channels and low stream terraces
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

0 to 9 inches—black, calcareous silt loam
9 to 21 inches—gray, calcareous silt loam
21 to 28 inches—light brownish gray, mottled, calcareous silt loam
28 to 52 inches—olive, mottled, calcareous silt loam
52 to 60 inches—pale olive, mottled, calcareous very fine sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately slow or moderate
Available water capacity: High

Organic matter content: High
Surface runoff: Slow
Seasonal high water table: At the surface to 1 foot below the surface
Special characteristics: Subject to occasional flooding for brief periods

Inclusions

Contrasting inclusions:
- The poorly drained Lamoure soils, which have a thicker dark surface layer than the Colvin soil; in concave areas
- The moderately well drained Fairdale soils, which are higher on the landscape than the Colvin soil and have less silt
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a surface layer of silty clay loam
- Soils that have small seams and pockets of sand or gravel

Use and Management

Cropland

Major management factors: Wetness, soil blowing, high pH
- Most crops suited to the county can be grown if adequate drainage is provided. Providing drainage is difficult, however, because most areas have poor outlets.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Wetness
- Restricting grazing during wet periods helps to prevent compaction of the surface layer.
- Pasture grasses that are tolerant of seasonal wetness should be seeded.

Interpretive Groups

Land capability classification: 3w
Windbreak suitability group: 2K, drained; 10, undrained

767—Auganaush loam

Composition

Auganaush soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Drainageways and low flat areas on moraines
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 5 inches—black loam
5 to 8 inches—dark grayish brown, mottled loam
8 to 17 inches—grayish brown, mottled clay
17 to 22 inches—olive gray, mottled silty clay loam
22 to 38 inches—olive gray, mottled, calcareous silty clay loam
38 to 60 inches—light olive gray, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate in the upper part, slow in the next part, moderately slow or slow in the lower part
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Mahkonce soils on foot slopes
- Very poorly drained soils in depressions

Similar soils:
- Soils that have small seams and pockets of sand or gravel
- Soils that have a surface layer of silt loam
- Soils that have less clay in the subsoil

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, plant competition, windthrow hazard
- Harvesting is limited to periods when the ground is frozen or dry.
- Using wheeled and tracked equipment on wet soil produces ruts, compacts the soil, and damages the roots of trees.
- Because of the potential for frost action, special construction and maintenance of logging roads are needed.
- Seasonal wetness and the clayey texture result in a high rate of seedling mortality.
- Measures that control plant competition are needed.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Many trees may be blown down during periods of high winds and excessive wetness.

Cropland

Major management factors: Wetness, high clay content
- Most of the crops suited to the county can be grown if adequate drainage is provided.
- Restricting fieldwork during wet periods minimizes surface compaction and helps to maintain tilth.
- Growing alfalfa, sweet clover, and other deep-rooted legumes opens channels in the clayey subsoil and helps to maintain drainage.

Pasture

Major management factors: Wetness, clay content
- Restricting grazing during wet periods helps to prevent compaction of the surface layer.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2w, drained; 4w, undrained
Woodland ordination symbol: 6W
Windbreak suitability group: 2, drained; 10, undrained

775B—Sugarbush-Two Inlets complex, 1 to 8 percent slopes

Composition

Sugarbush soil and similar soils: 55 to 75 percent
Two Inlets soil and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Hilltops and side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

Sugarbush

0 to 4 inches—black sandy loam
4 to 9 inches—yellowish brown loamy sand
9 to 27 inches—dark yellowish brown sandy loam
27 to 60 inches—yellowish brown, calcareous coarse sand

Two Inlets

0 to 2 inches—black coarse sandy loam
2 to 8 inches—dark yellowish brown loamy coarse sand
8 to 27 inches—brown loamy coarse sand
27 to 60 inches—yellowish brown, calcareous gravelly coarse sand

Soil Properties and Qualities

Drainage class: Sugarbush—well drained; Two Inlets—somewhat excessively drained
Permeability: Sugarbush—moderately rapid or rapid in the upper part, moderately rapid in the next part, very rapid in the lower part; Two Inlets—moderately rapid or rapid in the upper part, rapid or very rapid in the lower part
Available water capacity: Low
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Karlstad soils on foot slopes and hilltops
- The poorly drained Epoufette soils in drainageways and low areas
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a surface layer of fine sandy loam
- Soils that have more clay in the substratum
- Soils that have numerous cobble- to boulder-sized fragments throughout the profile

Use and Management

Woodland

Major management factors: Plant competition, seedling mortality
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because of droughtiness, the competition for moisture is severe.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.
- Poor seedling survival rates during dry years can be improved by careful planting of vigorous nursery stock.

Cropland

Major management factors: Soil blowing, available water capacity
- All of the crops suited to the county can be grown in areas of these soils.
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion and conserve moisture.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing and also collect snow for moisture.

Pasture

Major management factors: Fertility, plant competition
- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Sugarbush—3s; Two Inlets—4s

Woodland ordination symbol: Sugarbush—6A; Two Inlets—6S

Windbreak suitability group: Sugarbush—6G; Two Inlets—7

775C—Sugarbush-Two Inlets complex, 8 to 15 percent slopes

Composition

Sugarbush soil and similar soils: 50 to 65 percent
Two Inlets soil and similar soils: 35 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes on moraines

Shape of areas: Irregular

Size of areas: 3 to 100 acres

Typical Profile

Sugarbush

0 to 3 inches—very dark gray coarse sandy loam
3 to 10 inches—dark yellowish brown loamy sand
10 to 27 inches—brown sandy loam
27 to 60 inches—yellowish brown, calcareous coarse sand

Two Inlets

0 to 3 inches—very dark gray sandy loam
3 to 9 inches—dark yellowish brown loamy coarse sand
9 to 29 inches—brown gravelly loamy coarse sand
29 to 60 inches—yellowish brown, calcareous gravelly coarse sand

Soil Properties and Qualities

Drainage class: Sugarbush—well drained; Two Inlets—somewhat excessively drained

Permeability: Sugarbush—moderately rapid or rapid in the upper part, moderately rapid in the next part, very rapid in the lower part; Two Inlets—moderately rapid or rapid in the upper part, rapid or very rapid in the lower part

Available water capacity: Low

Organic matter content: Moderately low

Surface runoff: Medium

Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Karlstad soils on hilltops and foot slopes
- The poorly drained Epoufette soils in drainageways and low areas
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of fine sandy loam
- Soils that have more clay in the substratum
- Soils that have numerous cobble- to boulder-sized fragments throughout the profile

Use and Management

Woodland

Major management factors: Plant competition, seedling mortality

- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because of droughtiness, the competition for moisture is severe.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.
- Poor seedling survival rates during dry years can be improved by careful planting of vigorous nursery stock.

Cropland

Major management factors: Water erosion, soil blowing, available water capacity

- All of the crops suited to the county can be grown in areas of these soils.
- Tilling on the contour or across the slope, chisel plowing, using grassed waterways, and including alfalfa and grasses in the rotation help to control erosion and conserve moisture.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing and also collect snow for moisture.

Pasture

Major management factors: Fertility, plant competition

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Sugarbush—4e; Two Inlets—4s

Woodland ordination symbol: Sugarbush—6A; Two Inlets—6S

Windbreak suitability group: Sugarbush—6G; Two Inlets—7

776B—Snellman-Sugarbush complex, 2 to 8 percent slopes

Composition

Snellman soil and similar soils: 55 to 75 percent
Sugarbush soil and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Hilltops and side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 800 acres

Typical Profile

Snellman

0 to 2 inches—black sandy loam
2 to 18 inches—brown loamy sand
18 to 28 inches—dark yellowish brown sandy clay loam
28 to 33 inches—light yellowish brown sandy loam
33 to 60 inches—light yellowish brown, calcareous sandy loam

Sugarbush

0 to 3 inches—black sandy loam
3 to 13 inches—brown loamy sand
13 to 29 inches—dark yellowish brown sandy loam
29 to 35 inches—yellowish brown sandy loam
35 to 60 inches—yellowish brown, calcareous sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Snellman—moderate or moderately rapid in the upper part, moderate in the lower part; Sugarbush—moderately rapid or rapid in the upper part, moderately rapid in the next part, very rapid in the lower part
Available water capacity: Snellman—moderate; Sugarbush—low
Organic matter content: Snellman—moderately low or moderate; Sugarbush—moderately low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Wykeham and Karlstad soils on foot slopes and hilltops
- The poorly drained Egglake and Epoufette soils in drainageways and low areas
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of fine sandy loam
- Soils that have more clay in the substratum

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- When the soil is wet, unsurfaced roads and landings are slippery and ruts form easily.
- Competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Water erosion, soil blowing, available water capacity

- All of the crops suited to the county can be grown in areas of these soils.
- Tilling on the contour or across the slope, chisel plowing, using grassed waterways, and including alfalfa and grasses in the rotation help to control erosion and conserve moisture.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing and also collect snow for moisture.

Pasture

Major management factors: Fertility, plant competition

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Snellman—2e; Sugarbush—3s
Woodland ordination symbol: Snellman—6L; Sugarbush—6A
Windbreak suitability group: Snellman—3; Sugarbush—6G

776C—Snellman-Sugarbush complex, 8 to 15 percent slopes

Composition

Snellman soil and similar soils: 45 to 60 percent
Sugarbush soil and similar soils: 30 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Snellman

0 to 2 inches—very dark gray fine sandy loam
2 to 9 inches—yellowish brown loamy sand
9 to 18 inches—light yellowish brown loamy sand
18 to 26 inches—dark yellowish brown sandy clay loam
26 to 60 inches—yellowish brown, calcareous sandy loam

Sugarbush

0 to 2 inches—black sandy loam
2 to 12 inches—yellowish brown loamy sand
12 to 25 inches—dark yellowish brown sandy loam
25 to 60 inches—yellowish brown, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Snellman—moderate or moderately rapid in the upper part, moderate in the lower part; Sugarbush—moderately rapid or rapid in the upper part, moderately rapid in the next part, very rapid in the lower part
Available water capacity: Snellman—moderate; Sugarbush—low
Organic matter content: Snellman—moderately low or moderate; Sugarbush—moderately low
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Wykeham and Karlstad soils on hilltops and foot slopes
- The poorly drained Egglake and Epoufette soils in drainageways and low areas
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of loam
- Soils that have more clay in the substratum

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- When the soil is wet, unsurfaced roads and landings are slippery and ruts form easily.
- Competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Water erosion, soil blowing, available water capacity

- All of the crops suited to the county can be grown in areas of these soils.
- Tilling on the contour or across the slope, chisel plowing, using grassed waterways, and including alfalfa and grasses in the rotation help to control erosion and conserve moisture.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing and also collect snow for moisture.

Pasture

Major management factors: Fertility, plant competition

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Snellman—3e; Sugarbush—4e
Woodland ordination symbol: Snellman—6L; Sugarbush—6A
Windbreak suitability group: Snellman—3; Sugarbush—6G

776E—Snellman-Sugarbush complex, 15 to 30 percent slopes

Composition

Snellman soil and similar soils: 40 to 55 percent
Sugarbush soil and similar soils: 35 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

Snellman

0 to 2 inches—very dark gray sandy loam
2 to 12 inches—light yellowish brown loamy sand
12 to 22 inches—dark yellowish brown sandy clay loam
22 to 60 inches—yellowish brown, calcareous sandy loam

Sugarbush

0 to 1 inch—very dark gray sandy loam
1 to 9 inches—yellowish brown loamy coarse sand
9 to 22 inches—dark yellowish brown sandy loam
22 to 60 inches—light yellowish brown, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Snellman—moderate or moderately rapid in the upper part, moderate in the lower part; Sugarbush—moderately rapid or rapid in the upper part, moderately rapid in the next part, very rapid in the lower part
Available water capacity: Snellman—moderate; Sugarbush—low
Organic matter content: Snellman—moderately low or moderate; Sugarbush—moderately low
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Wykeham and Karlstad soils on hilltops and foot slopes
- The poorly drained Egglake and Epoufette soils in drainageways and low areas
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a surface layer of loam
- Soils that have more clay in the substratum

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition
- When the soil is wet, unsurfaced roads and landings are slippery and ruts form easily.
- Using conventional harvesting methods is difficult because of the slope.
- Competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Slope
- These soils are generally not suited to crops because of the slope.

Pasture

Major management factors: Slope, fertility
- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 6e
Woodland ordination symbol: Snellman—6R; Sugarbush—6R
Windbreak suitability group: Snellman—3; Sugarbush—6G

827B—Heimdal-Esmond complex, 2 to 6 percent slopes

Composition

Heimdal soil and similar soils: 50 to 75 percent
Esmond soil and similar soils: 15 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Heimdal—hilltops and side slopes on moraines; Esmond—shoulder slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Heimdal

0 to 8 inches—very dark gray loam
8 to 17 inches—dark brown loam
17 to 60 inches—light olive brown, calcareous loam

Esmond

0 to 7 inches—very dark grayish brown, calcareous loam
7 to 13 inches—yellowish brown, calcareous loam
13 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Heimdal—moderate or high; Esmond—moderately low or moderate
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The poorly drained Hedman soils in drainageways and low flat areas
- The moderately well drained Fram soils on hilltops and foot slopes
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a surface layer of sandy loam or fine sandy loam
- Soils that have small seams and pockets of sand or gravel
- Soils that have more clay and less sand

Use and Management

Cropland

Major management factors: Heimdal—water erosion; Esmond—water erosion, organic matter content, soil blowing, high pH

- All of the crops suited to the county can be grown in areas of these soils.
- Using conservation tillage and working the fields across the slope help to control erosion.
- Using high-residue crops in a suitable rotation and returning crop residue to the soil help to maintain the content of organic matter.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Fertility, plant competition

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Heimdal—2e; Esmond—3e
Windbreak suitability group: Heimdal—3; Esmond—8

827C2—Heimdal-Esmond complex, 6 to 12 percent slopes, eroded

Composition

Heimdal soil and similar soils: 45 to 75 percent
Esmond soil and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Heimdal—side slopes on moraines; Esmond—shoulder slopes on moraines (fig. 9)
Shape of areas: Irregular
Size of areas: 3 to 80 acres

Typical Profile

Heimdal

0 to 8 inches—very dark gray and dark grayish brown loam
8 to 15 inches—dark brown loam
15 to 60 inches—yellowish brown, calcareous loam

Esmond

0 to 8 inches—very dark gray, calcareous loam
8 to 24 inches—light yellowish brown, calcareous loam
24 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Heimdal—moderate or high; Esmond—moderately low or moderate
Surface runoff: Medium
Depth to the water table: More than 6 feet
Special characteristics: Moderately eroded or severely eroded in the strongly convex positions

Inclusions

Contrasting inclusions:

- The poorly drained Hedman soils in drainageways
- The moderately well drained Fram soils on hilltops and foot slopes
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of sandy loam or fine sandy loam
- Soils that have small seams and pockets of sand or gravel
- Soils that have more clay and less sand

Use and Management

Cropland

Major management factors: Heimdal—water erosion; Esmond—water erosion, organic matter content, soil blowing, high pH

- All of the crops suited to the county can be grown in areas of these soils.
- Productivity has been reduced by erosion. Unless the soils are protected, productivity will continue to decline.
- Tilling on the contour or across the slope, using conservation tillage, and installing grassed waterways help to control erosion.
- Using high-residue crops in a suitable rotation and returning crop residue to the soil help to maintain the content of organic matter.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Fertility, plant competition

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Heimdal—3e; Esmond—6e

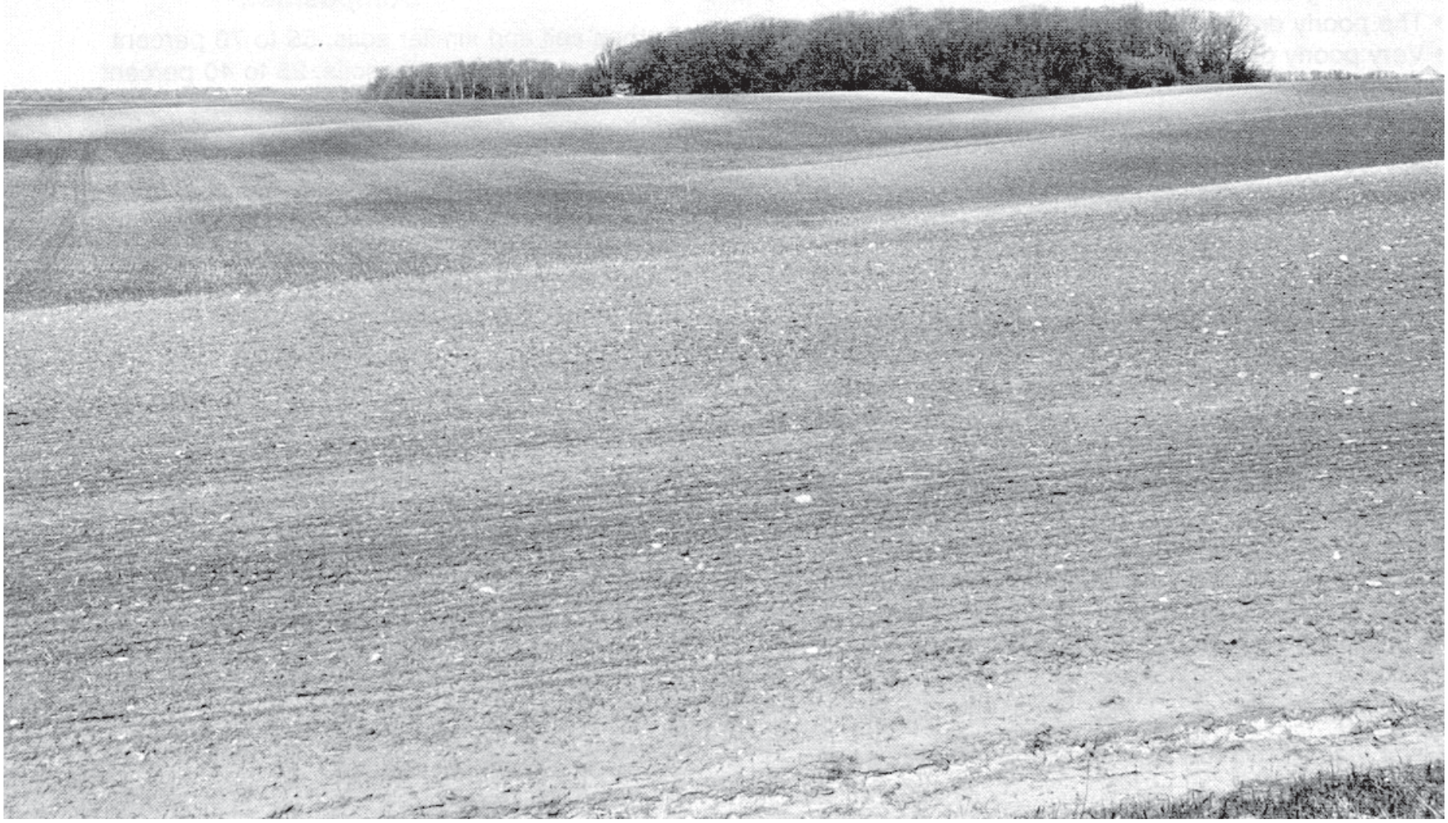

Figure 9.—An area of Heimdal-Esmond complex, 6 to 12 percent slopes, eroded. The Heimdal soil is in the darker areas on the lower side slopes, and the Esmond soil is in the lighter areas on the upper side slopes.

Windbreak suitability group: Heimdal—3; Esmond—8

867B—Graycalm-Menahga complex, 1 to 8 percent slopes

Composition

Graycalm soil and similar soils: 50 to 60 percent
Menahga soil and similar soils: 35 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Hilltops and side slopes on outwash plains
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

Graycalm

0 to 2 inches—very dark brown loamy sand
2 to 9 inches—yellowish brown loamy sand
9 to 18 inches—brown sand
18 to 60 inches—pale brown sand that has bands of dark brown sandy loam

Menahga

0 to 3 inches—black loamy sand
3 to 8 inches—dark gray loamy sand
8 to 22 inches—brown loamy sand
22 to 50 inches—yellowish brown sand
50 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Drainage class: Graycalm—somewhat excessively drained; Menahga—excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow

Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The poorly drained Epoufette soils in drainageways
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a thicker dark surface layer
- Soils that have more clay
- Soils that have thicker loamy bands

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality

- Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods.
- Because of droughtiness, the competition for moisture is severe.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.
- Poor seedling survival rates during dry years can be improved by careful planting of vigorous nursery stock.

Cropland

Major management factors: Available water capacity, soil blowing

- All of the crops suited to the county can be grown in areas of these soils.
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion and conserve moisture.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing and also collect snow for moisture.

Pasture

Major management factors: Fertility, plant competition

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 4s
Woodland ordination symbol: Graycalm—7A; Menahga—6S
Windbreak suitability group: 7

903B—Barnes-Langhei complex, 2 to 6 percent slopes

Composition

Barnes soil and similar soils: 55 to 70 percent
Langhei soil and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Barnes—hilltops and side slopes on moraines; Langhei—shoulder slopes on moraines (fig. 10)
Shape of areas: Irregular
Size of areas: 3 to 1,000 acres

Typical Profile

Barnes

0 to 7 inches—very dark gray loam
7 to 14 inches—dark brown loam
14 to 34 inches—yellowish brown, calcareous loam
34 to 60 inches—light olive brown, calcareous loam

Langhei

0 to 5 inches—very dark grayish brown, calcareous loam
5 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Barnes—moderate or high; Langhei—low to moderate
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Hamlet soils on hilltops and foot slopes
- The poorly drained Flom soils in drainageways and low areas
- Very poorly drained soils in depressions

Similar soils:
- Soils that have less clay and more sand
- Soils that have small seams and pockets of sand or gravel
- Soils that have more clay in the subsoil

Use and Management

Cropland

Major management factors: Barnes—water erosion;

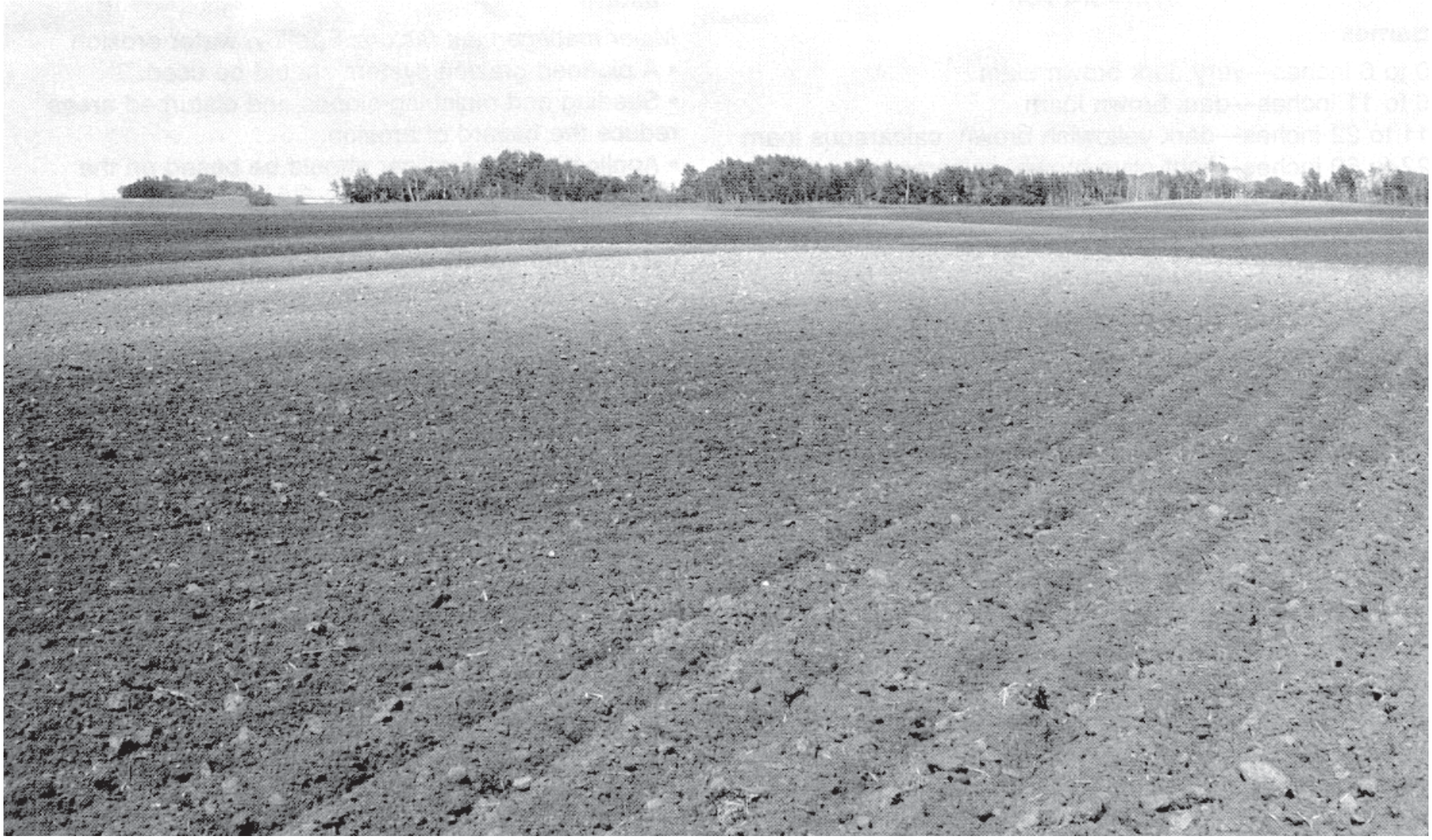

Figure 10.—A typical landscape in an area of Barnes-Langhei complex, 2 to 6 percent slopes. The Barnes soil is in the darker areas, and the Langhei soil is in the lighter areas.

Langhei—water erosion, organic matter content, soil blowing, high pH

- All of the crops suited to the county can be grown in areas of these soils.
- Using conservation tillage and working the fields across the slope help to control erosion.
- Using high-residue crops in a suitable rotation and returning crop residue to the soil help to maintain the content of organic matter.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Fertility, plant competition

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Barnes—2e; Langhei—3e
Windbreak suitability group: Barnes—3; Langhei—8

903C2—Barnes-Langhei complex, 6 to 12 percent slopes, eroded

Composition

Barnes soil and similar soils: 45 to 60 percent
Langhei soil and similar soils: 30 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Barnes—side slopes on moraines; Langhei—shoulder slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Barnes

0 to 6 inches—very dark brown loam
6 to 11 inches—dark brown loam
11 to 22 inches—dark yellowish brown, calcareous loam
22 to 60 inches—light olive brown, calcareous loam

Langhei

0 to 4 inches—dark grayish brown, calcareous loam
4 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Barnes—moderate or high; Langhei—low to moderate
Surface runoff: Medium
Depth to the water table: More than 6 feet
Special characteristics: Moderately eroded or severely eroded in the strongly convex positions

Inclusions

Contrasting inclusions:

- The moderately well drained Hamlet soils on hilltops and foot slopes
- The moderately well drained Darnen soils on foot slopes
- The poorly drained Flom soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have less clay and more sand
- Soils that have small seams and pockets of sand or gravel
- Soils that have more clay in the subsoil

Use and Management

Cropland

Major management factors: Barnes—water erosion; Langhei—water erosion, organic matter content, soil blowing, high pH

- All of the crops suited to the county can be grown in areas of these soils.
- Productivity has been reduced by erosion. Unless the soils are protected, productivity will continue to decline.
- Tilling on the contour or across the slope, using conservation tillage, and installing grassed waterways help to control erosion.
- Using high-residue crops in a suitable rotation and returning crop residue to the soil help to maintain the content of organic matter.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Fertility, water erosion

- A planned grazing system should be used.
- Seeding and mulching slopes and disturbed areas reduce the hazard of erosion.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Barnes—3e; Langhei—4e
Windbreak suitability group: Barnes—3; Langhei—8

942D2—Langhei-Barnes complex, 12 to 20 percent slopes, eroded

Composition

Langhei soil and similar soils: 50 to 70 percent
Barnes soil and similar soils: 25 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Langhei—shoulder slopes on moraines; Barnes—side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 75 acres

Typical Profile

Langhei

0 to 6 inches—dark grayish brown, calcareous loam
6 to 60 inches—light olive brown, calcareous loam

Barnes

0 to 7 inches—very dark grayish brown loam
7 to 13 inches—dark yellowish brown loam
13 to 20 inches—yellowish brown, calcareous loam
20 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Langhei—low to moderate; Barnes—moderate or high
Surface runoff: Rapid
Depth to the water table: More than 6 feet
Special characteristics: Moderately eroded or severely eroded in the strongly convex positions

Inclusions

Contrasting inclusions:

- The moderately well drained Darnen soils on foot slopes

- The poorly drained Flom soils in drainageways

Similar soils:
- Soils that have less clay and more sand
- Soils that have small seams and pockets of sand or gravel
- Soils that have more clay in the subsoil

Use and Management

Cropland

Major management factors: Langhei—water erosion, organic matter content, soil blowing, high pH; Barnes—water erosion
- Small grain and hay are the best suited crops.
- Productivity has been reduced by erosion. Unless the soils are protected, productivity will continue to decline.
- Tilling on the contour or across the slope, using conservation tillage, and installing grassed waterways help to control erosion.
- Using high-residue crops in a suitable rotation and returning crop residue to the soil help to maintain the content of organic matter.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Fertility, water erosion
- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Seeding and mulching slopes and disturbed areas reduce the hazard of erosion.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Langhei—6e; Barnes—4e
Windbreak suitability group: Langhei—8; Barnes—3

967B—Waukon-Langhei complex, 2 to 6 percent slopes

Composition

Waukon soil and similar soils: 55 to 75 percent
Langhei soil and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Waukon—hilltops and side slopes on moraines; Langhei—shoulder slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 800 acres

Typical Profile

Waukon

0 to 6 inches—very dark gray loam
6 to 14 inches—dark brown clay loam
14 to 20 inches—yellowish brown clay loam
20 to 60 inches—light yellowish brown, calcareous loam

Langhei

0 to 6 inches—dark grayish brown, calcareous loam
6 to 39 inches—olive brown, calcareous loam
39 to 60 inches—light yellowish brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Waukon—moderate or high; Langhei—low to moderate
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Gonvick soils on hilltops and foot slopes
- The poorly drained Flom soils in drainageways and low areas
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a surface layer of sandy loam
- Soils that have small seams and pockets of sand or gravel
- Soils that have more clay in the subsoil
- Soils that have a thicker dark surface layer

Use and Management

Cropland

Major management factors: Waukon—water erosion; Langhei—water erosion, organic matter content, soil blowing, high pH
- All of the crops suited to the county can be grown in areas of these soils.
- Using conservation tillage and working the fields across the slope help to control erosion.
- Using high-residue crops in a suitable rotation and returning crop residue to the soil help to maintain the content of organic matter.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Fertility, plant competition
- A planned grazing system should be used.

- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Waukon—2e; Langhei—3e
Windbreak suitability group: Waukon—3; Langhei—8

967C2—Waukon-Langhei complex, 6 to 12 percent slopes, eroded

Composition

Waukon soil and similar soils: 45 to 65 percent
Langhei soil and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Waukon—side slopes on moraines; Langhei—shoulder slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Waukon

0 to 6 inches—very dark grayish brown loam
6 to 15 inches—dark brown clay loam
15 to 28 inches—yellowish brown, calcareous loam
28 to 60 inches—light yellowish brown, calcareous loam

Langhei

0 to 6 inches—dark grayish brown, calcareous loam
6 to 19 inches—brown, calcareous loam
19 to 60 inches—yellowish brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Waukon—moderate or high; Langhei—low to moderate
Surface runoff: Medium
Depth to the water table: More than 6 feet
Special characteristics: Moderately eroded or severely eroded in the strongly convex positions

Inclusions

Contrasting inclusions:

- The moderately well drained Darnen soils on foot slopes
- The poorly drained Flom soils in drainageways
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of sandy loam
- Soils that have small seams and pockets of sand or gravel
- Soils that have more clay in the subsoil
- Soils that have a thicker dark surface layer

Use and Management

Cropland

Major management factors: Waukon—water erosion; Langhei—water erosion, organic matter content, soil blowing, high pH

- All of the crops suited to the county can be grown in areas of these soils.
- Productivity has been reduced by erosion. Unless the soils are protected, productivity will continue to decline.
- Tilling on the contour or across the slope (fig. 11), using conservation tillage, and installing grassed waterways help to control erosion.
- Using high-residue crops in a suitable rotation and returning crop residue to the soil help to maintain the content of organic matter.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Fertility, water erosion

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Seeding and mulching slopes and disturbed areas reduce the hazard of erosion.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Waukon—3e; Langhei—4e
Windbreak suitability group: Waukon—3; Langhei—8

979D2—Langhei-Waukon complex, 12 to 20 percent slopes, eroded

Composition

Langhei soil and similar soils: 45 to 60 percent
Waukon soil and similar soils: 35 to 55 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Langhei—shoulder slopes on moraines; Waukon—side slopes on moraines (fig. 12)
Shape of areas: Irregular
Size of areas: 3 to 75 acres

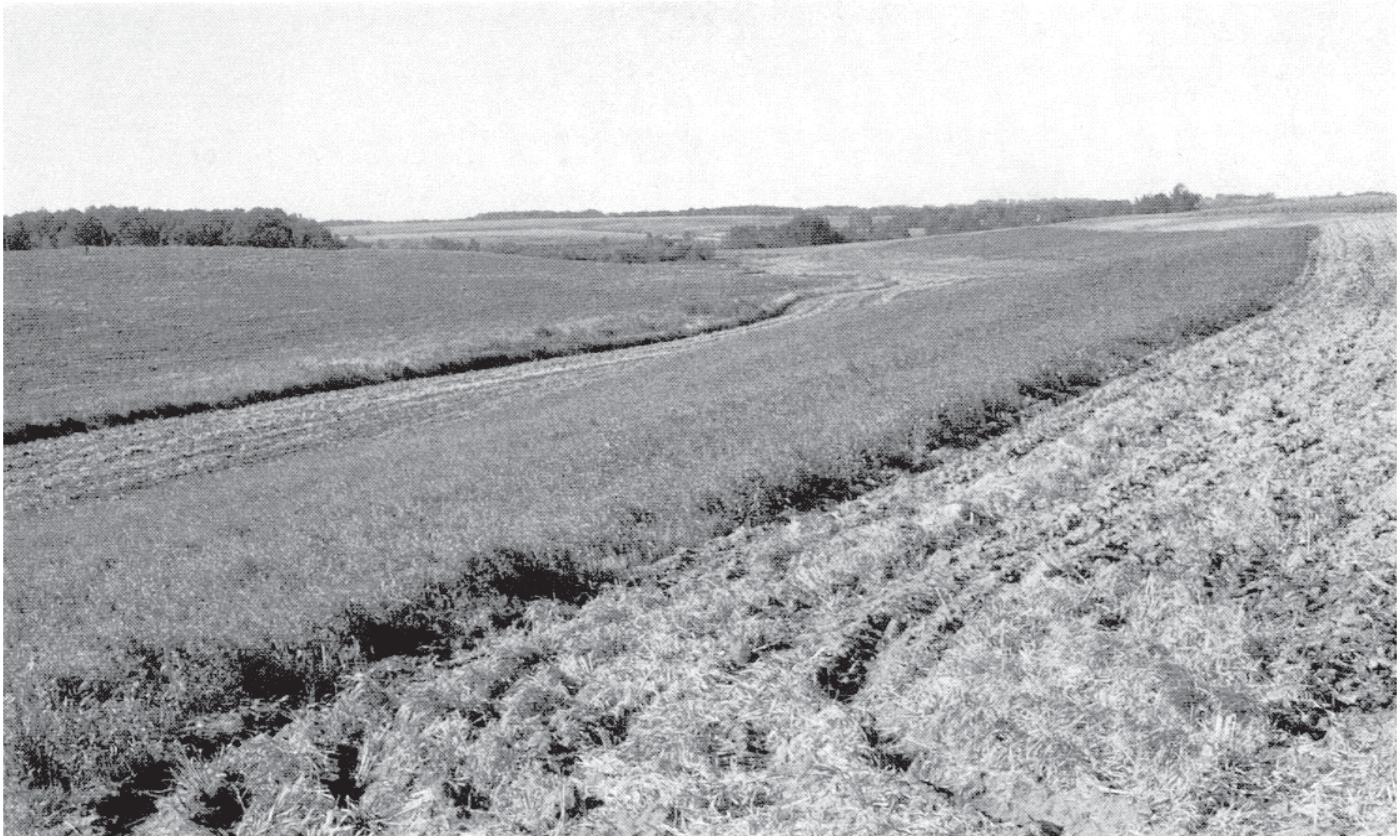

Figure 11.—Contour farming in an area of Waukon-Langhei complex, 6 to 12 percent slopes, eroded.

Typical Profile

Langhei

0 to 5 inches—dark grayish brown, calcareous loam
5 to 60 inches—light olive brown, calcareous loam

Waukon

0 to 6 inches—very dark grayish brown loam
6 to 14 inches—brown clay loam
14 to 60 inches—light olive brown, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Langhei—low; Waukon—moderate or high
Surface runoff: Rapid
Depth to the water table: More than 6 feet
Special characteristics: Moderately eroded or severely eroded in the strongly convex positions

Inclusions

Contrasting inclusions:

- The moderately well drained Darnen soils on foot slopes
- The poorly drained Flom soils in drainageways

Similar soils:

- Soils that have a surface layer and subsoil of sandy loam
- Soils that have more clay in the subsoil

Use and Management

Cropland

Major management factors: Langhei—water erosion, organic matter content, soil blowing, high pH; Waukon—water erosion

- Small grain and hay are the best suited crops.
- Productivity has been reduced by erosion. Unless the soils are protected, productivity will continue to decline.
- Tilling on the contour or across the slope, using conservation tillage, and installing grassed waterways help to control erosion.

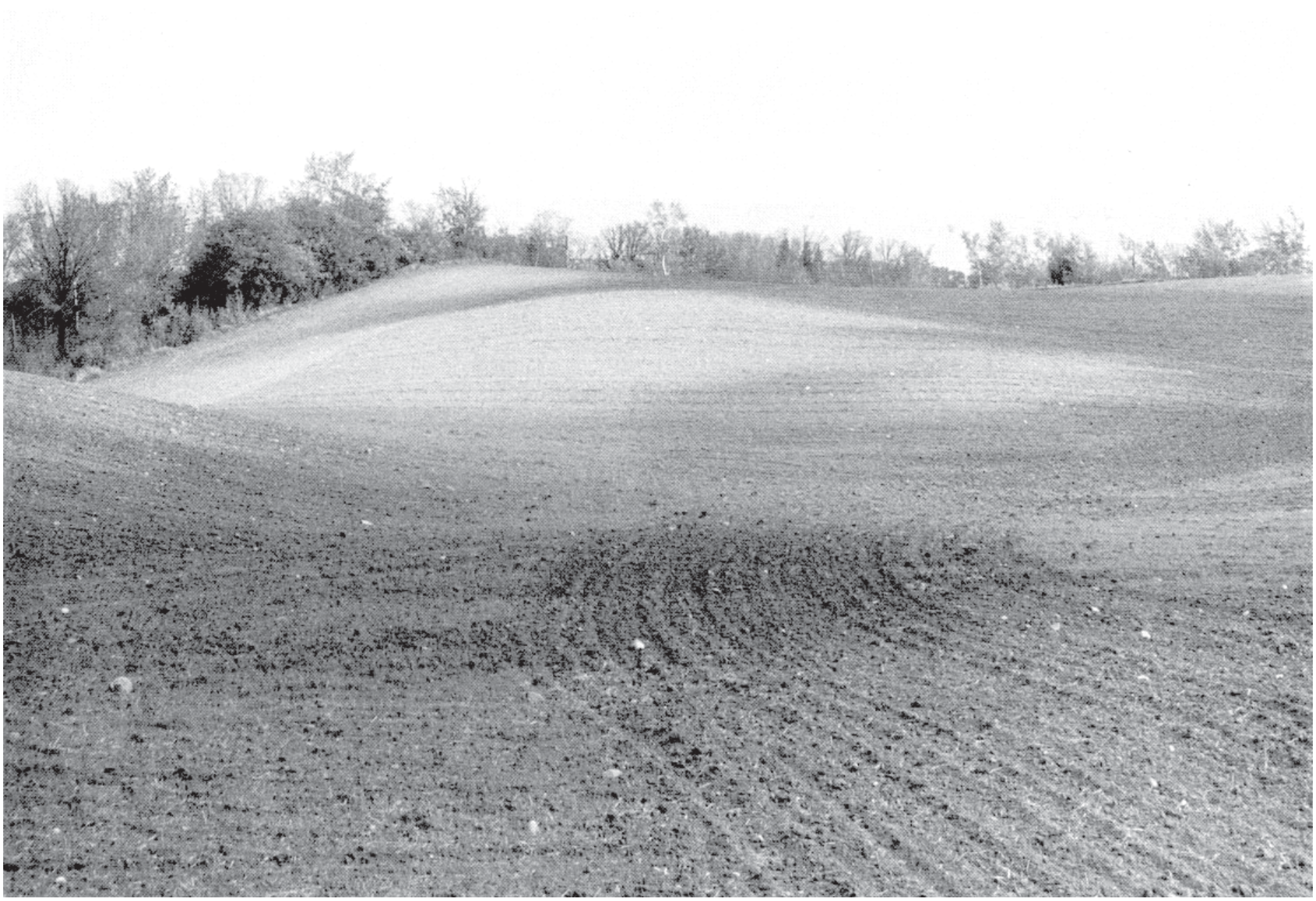

Figure 12.—An area of Langhei-Waukon complex, 12 to 20 percent slopes, eroded. The Langhei soil is in the lighter areas, and the Waukon soil is in the darker areas. Areas of the included Darnen soils are on foot slopes in the foreground.

- Using high-residue crops in a suitable rotation and returning crop residue to the soil help to maintain the content of organic matter.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Fertility, water erosion
- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Seeding and mulching slopes and disturbed areas reduce the hazard of erosion.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Langhei—6e; Waukon—4e
Windbreak suitability group: Langhei—8; Waukon—3

1030—Pits, gravel-Udipsamments complex

Description of areas: Active or abandoned areas that were used for sand and gravel pits; consisting of excavations, stockpiles of sand and gravel, areas filled with waste, and some ponded areas
Size of areas: About 5 to 80 acres
Shape of areas: Irregular
Inclusions: Borrow pits from which loamy material has been removed
Use and management:
- These areas can be reclaimed and used for several

different purposes. Reclamation generally includes intensive filling and grading. In some areas topsoil and material from the subsoil can be stockpiled.

- Natural revegetation of grasses and brush has begun in some areas.
- If reclaimed, some areas could be used for commercial or industrial development.
- Wildlife habitat or recreational areas can be developed by revegetating and by utilizing the ponds that are in some areas.
- Onsite investigation is needed to determine the potential and limitations of these areas for proposed uses.

Interpretive groups: Not assigned

1113—Haslie, Seelyeville, and Cathro soils, ponded

Composition

Haslie soil and similar soils: 0 to 95 percent
Seelyeville soil and similar soils: 0 to 95 percent
Cathro soil and similar soils: 0 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Depressions on moraines and outwash plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 5 to 200 acres
Special characteristics: Ponding

Typical Profile

Haslie

0 to 30 inches—black muck
30 to 48 inches—dark olive gray, mottled, calcareous coprogenous earth
48 to 60 inches—olive gray, mottled, calcareous coprogenous earth

Seelyeville

0 to 22 inches—black muck
22 to 60 inches—very dark brown muck

Cathro

0 to 37 inches—black muck
37 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Haslie—moderate or moderately rapid in the upper part, slow in the lower part; Seelyeville—moderately slow to moderately rapid; Cathro—moderately slow to moderately rapid in the upper part, moderately slow or moderate in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded
Seasonal high water table: Haslie—1 foot above to 1 foot below the surface; Seelyeville and Cathro—4.0 feet above to 0.5 foot below the surface

Inclusions

Contrasting inclusions:

- Poorly drained and very poorly drained, mineral soils at the margins of the map unit

Similar soils:

- Soils that have sand below the layers of muck

Use and Management

Woodland

Major management factors: Ponding, wetness

- These soils are not suited to woodland. Ponding restricts the growth of trees.

Cropland

Major management factors: Ponding, wetness

- These soils are not suited to crops because of ponding during the growing season.

Pasture

Major management factors: Ponding, wetness

- Because of the ponding, only water-tolerant plants, such as cattails, reeds, and sedges, can be grown.

Interpretive Groups

Land capability classification: 8w
Windbreak suitability group: 10

1117—Hedman loam

Composition

Hedman soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Drainageways, edges of depressions, and low flat areas on moraines
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 12 inches—black, calcareous loam
12 to 17 inches—dark gray, mottled, calcareous loam
17 to 21 inches—dark grayish brown, mottled, calcareous fine sandy loam

21 to 46 inches—grayish brown, mottled, calcareous loam
46 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Seasonal high water table: At the surface to 2 feet below the surface

Inclusions

Contrasting inclusions:
- The moderately well drained Fram soils on knolls
- The poorly drained Rockwell soils, which have a sandy upper mantle
- Very poorly drained soils in depressions

Similar soils:
- Soils that have more sand in the surface layer
- Soils that are noncalcareous at or near the surface
- Soils that have small seams and pockets of sand or gravel

Use and Management

Cropland

Major management factors: Wetness, soil blowing, high pH
- Most crops suited to the county can be grown if adequate drainage is provided.
- Restricting fieldwork during wet periods minimizes surface compaction and helps to maintain tilth.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Wetness, plant competition
- Grazing during wet periods results in compaction of the surface layer and restricts plant growth.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2w
Windbreak suitability group: 2K, drained; 10, undrained

1139—Marysland loam, occasionally flooded

Composition

Marysland soil and similar soils: 85 to 98 percent
Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Plane and slightly concave areas in outwash channels and on stream terraces
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

0 to 8 inches—black, calcareous loam
8 to 16 inches—very dark gray, calcareous loam
16 to 21 inches—dark gray, calcareous loam
21 to 33 inches—grayish brown, mottled, calcareous loam
33 to 37 inches—light brownish gray, mottled, calcareous loamy fine sand
37 to 60 inches—light brownish gray, mottled, calcareous sand

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow
Depth to the water table: 0.5 foot to 1.5 feet
Special characteristics: Subject to occasional flooding for brief periods

Inclusions

Contrasting inclusions:
- The poorly drained Lamoure soils, which do not have a sandy substratum
- The moderately well drained Fairdale soils on the higher terraces
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a surface layer of silt loam or silty clay loam

Use and Management

Cropland

Major management factors: Wetness, soil blowing, high pH
- Most crops suited to the county can be grown if adequate drainage is provided.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Wetness, plant competition
- Grazing during wet periods results in compaction of the surface layer and restricts plant growth.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 3w
Windbreak suitability group: 2K, drained; 10, undrained

1142—Hedman-Fram complex

Composition

Hedman soil and similar soils: 45 to 60 percent
Fram soil and similar soils: 35 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Hedman—drainageways, edges of depressions, and low flat areas on moraines; Fram—plane and slightly convex knolls on moraines
Slope range: Hedman—0 to 2 percent; Fram—1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 1,000 acres

Typical Profile

Hedman

0 to 13 inches—black, calcareous loam
13 to 21 inches—dark grayish brown, mottled, calcareous fine sandy loam
21 to 35 inches—grayish brown, mottled, calcareous loam
35 to 60 inches—light brownish gray, mottled, calcareous loam

Fram

0 to 9 inches—black, calcareous loam
9 to 19 inches—grayish brown, calcareous fine sandy loam
19 to 30 inches—yellowish brown, mottled, calcareous loam
30 to 60 inches—grayish brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Hedman—poorly drained; Fram—somewhat poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Hedman—high; Fram—high or very high
Surface runoff: Slow
Seasonal high water table: Hedman—at the surface to 2 feet below the surface; Fram—at a depth of 2 to 6 feet

Inclusions

Contrasting inclusions:
- The well drained Esmond and Heimdal soils on hilltops and side slopes
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a surface layer of sandy loam or silt loam
- Soils that have a noncalcareous surface layer
- Soils that have small seams and pockets of sand or gravel
- Soils that have more clay and less sand

Use and Management

Cropland

Major management factors: Hedman—wetness, high pH, soil blowing; Fram—high pH, soil blowing
- Most of the crops suited to the county can be grown if adequate drainage is provided (fig. 13).
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Plant competition, wetness
- A planned grazing system should be used.
- Grazing during wet periods results in compaction of the surface layer and restricts plant growth.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Hedman—2w; Fram—2e
Windbreak suitability group: Hedman—2K, drained, 10, undrained; Fram—1K

1147—Fordum, Fairdale, and Lamoure soils, frequently flooded

Composition

Fordum soil and similar soils: 0 to 95 percent
Fairdale soil and similar soils: 0 to 95 percent
Lamoure soil and similar soils: 0 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Fordum—plane

Figure 13.—Barley and corn in an area of Hedman-Fram complex.

and slightly concave areas on flood plains; Fairdale—plane and slightly convex areas on flood plains; Lamoure—plane and concave areas on flood plains

Slope range: 0 to 3 percent

Shape of areas: Long and narrow

Size of areas: 10 to 1,000 acres

Typical Profile

Fordum

0 to 9 inches—very dark gray loam

9 to 25 inches—very dark grayish brown, mottled, calcareous very fine sandy loam

25 to 30 inches—brown, mottled, calcareous loamy sand

30 to 38 inches—very dark grayish brown, mottled, calcareous fine sandy loam

38 to 60 inches—grayish brown, mottled, calcareous sand

Fairdale

0 to 8 inches—black silt loam

8 to 15 inches—dark grayish brown, calcareous loam

15 to 20 inches—dark grayish brown, calcareous very fine sandy loam

20 to 32 inches—dark grayish brown, mottled, calcareous loam

32 to 37 inches—dark grayish brown, mottled, calcareous very fine sandy loam

37 to 48 inches—grayish brown, mottled, calcareous silt loam

48 to 60 inches—grayish brown, mottled, calcareous loam

Lamoure

0 to 11 inches—black, calcareous silty clay loam

11 to 25 inches—very dark gray, calcareous silty clay loam

25 to 38 inches—dark gray, mottled, calcareous silty clay loam
38 to 60 inches—dark grayish brown, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Fordum—poorly drained; Fairdale—moderately well drained; Lamoure—poorly drained
Permeability: Fordum—moderate or moderately rapid in the upper part, rapid or very rapid in the lower part; Fairdale—moderate; Lamoure—moderately slow or moderate
Available water capacity: Fordum—moderate; Fairdale—very high; Lamoure—high
Organic matter content: Fordum—high or very high; Fairdale—moderate or high; Lamoure—high
Surface runoff: Slow
Seasonal high water table: Fordum—1 foot above to 1 foot below the surface; Fairdale—at a depth of 3.5 to 6.0 feet; Lamoure—at the surface to 2 feet below the surface
Special characteristics: Subject to frequent flooding after periods of snowmelt or heavy rainfall

Inclusions

Contrasting inclusions:
- Soils that have a surface layer of muck

Similar soils:
- Soils that have layers of silty clay or clay

Use and Management

Cropland

Major management factors: Frequent flooding, wetness
- These soils are not suited to crops because of the flooding during the growing season.

Pasture

Major management factors: Frequent flooding, wetness
- Only pasture grasses that are tolerant of periodic flooding and seasonal wetness should be seeded.
- Grazing when the soil is wet results in compaction of the surface layer and restricts plant growth.
- Additional fence maintenance is required because of the frequent flooding.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 6w
Windbreak suitability group: 10

1148—Fairdale and Lamoure soils, occasionally flooded

Composition

Fairdale soil and similar soils: 0 to 95 percent
Lamoure soil and similar soils: 0 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Fairdale—plane and slightly convex areas on flood plains; Lamoure—plane and concave areas on flood plains
Slope range: 0 to 3 percent
Shape of areas: Long and narrow
Size of areas: 10 to 200 acres

Typical Profile

Fairdale

0 to 7 inches—black, calcareous loam
7 to 14 inches—dark grayish brown, calcareous loam
14 to 22 inches—dark grayish brown, calcareous silt loam
22 to 28 inches—grayish brown, mottled, calcareous very fine sandy loam
28 to 34 inches—very dark gray and grayish brown, mottled, calcareous loam
34 to 46 inches—grayish brown, mottled, calcareous fine sandy loam
46 to 60 inches—grayish brown, mottled, calcareous loam

Lamoure

0 to 19 inches—black, calcareous silty clay loam
19 to 26 inches—very dark gray, calcareous silty clay loam
26 to 31 inches—gray, mottled, calcareous silty clay loam
31 to 44 inches—very dark gray, mottled, calcareous silt loam
44 to 60 inches—olive gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Fairdale—moderately well drained; Lamoure—poorly drained
Permeability: Fairdale—moderate; Lamoure—moderately slow or moderate
Available water capacity: Fairdale—very high; Lamoure—high
Organic matter content: Fairdale—moderate or high; Lamoure—high
Surface runoff: Slow
Seasonal high water table: Fairdale—3.5 to 6.0 feet; Lamoure—at the surface to 2 feet below the surface
Frequency of flooding: Occasional

Special characteristics: Subject to occasional flooding for brief periods

Inclusions

Contrasting inclusions:
- Soils that have a surface layer of muck
- Soils that have more sand

Similar soils:
- Soils that have layers of silty clay or clay

Use and Management

Cropland

Major management factors: Wetness, soil blowing
- Most crops can be grown if adequate drainage is provided. Providing drainage is difficult, however, because most areas have poor outlets.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.

Pasture

Major management factors: Wetness, plant competition
- Only pasture grasses that are tolerant of seasonal wetness should be seeded.
- Grazing when the soil is wet results in compaction of the surface layer.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Fairdale—2w; Lamoure—2w, drained, 4w, undrained
Windbreak suitability group: Fairdale—1; Lamoure—2, drained, 10, undrained

1149—Hamerly clay loam

Composition

Hamerly soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Plane and slightly convex knolls on moraines
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

0 to 9 inches—black, calcareous clay loam
9 to 13 inches—very dark grayish brown, calcareous clay loam
13 to 23 inches—light olive brown, calcareous loam
23 to 60 inches—light olive brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Medium or slow
Depth to the water table: 2 to 4 feet

Inclusions

Contrasting inclusions:
- The poorly drained Vallers soils in the lower concave areas
- The well drained Barnes soils on side slopes
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a surface layer of silt loam
- Soils that have small seams and pockets of sand or gravel
- Soils that are noncalcareous at or near the surface

Use and Management

Cropland

Major management factors: Soil blowing, high pH
- All of the crops suited to the county can be grown in areas of this soil.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Plant competition
- A planned grazing system should be used.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2s
Windbreak suitability group: 1K

1152B—Sugarbush loamy sand, 1 to 8 percent slopes

Composition

Sugarbush soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Hilltops and side slopes on outwash plains and valley trains
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

0 to 4 inches—black loamy sand
4 to 7 inches—dark brown loamy sand
7 to 17 inches—dark yellowish brown sandy loam
17 to 22 inches—dark brown sandy loam
22 to 31 inches—brown, calcareous coarse sand
31 to 60 inches—brown, calcareous gravelly coarse sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Rapid in the upper part, moderately rapid in the next part, very rapid in the lower part
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat excessively drained Two Inlets soils on side slopes
- The moderately well drained Karlstad soils on concave hilltops and foot slopes
- The poorly drained Epoufette soils in drainageways

Similar soils:

- Soils that have a surface layer of sandy loam
- Soils that have more clay in the subsoil
- Soils that have less clay in the subsoil
- Soils that have more gravel in the substratum
- Soils that have numerous cobble- to boulder-sized fragments throughout the profile

Use and Management

Woodland

Major management factors: Plant competition

- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because of droughtiness, the competition for moisture is severe.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.
- Poor seedling survival rates during dry years can be improved by careful planting of vigorous nursery stock.

Cropland

Major management factors: Available water capacity, soil blowing

- All of the crops suited to the county can be grown in areas of this soil.
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing and also collect snow for moisture.

Pasture

Major management factors: Fertility

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 3s
Woodland ordination symbol: 6A
Windbreak suitability group: 6G

1152C—Sugarbush loamy sand, 8 to 15 percent slopes

Composition

Sugarbush soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes on outwash plains and valley trains
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 5 inches—very dark gray loamy sand
5 to 8 inches—yellowish brown loamy sand
8 to 16 inches—dark yellowish brown sandy loam
16 to 60 inches—yellowish brown, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Rapid in the upper part, very rapid in the lower part
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat excessively drained Two Inlets soils on side slopes
- The moderately well drained Karlstad soils on hilltops and foot slopes
- The poorly drained Epoufette soils in drainageways

Similar soils:

- Soils that have a surface layer of sandy loam
- Soils that have more clay in the subsoil

- Soils that have less clay in the subsoil
- Soils that have more gravel
- Soils that have numerous cobble- to boulder-sized fragments throughout the profile

Use and Management

Woodland

Major management factors: Plant competition

- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because of droughtiness, the competition for moisture is severe.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.
- Poor seedling survival rates during dry years can be improved by careful planting of vigorous nursery stock.

Cropland

Major management factors: Water erosion, available water capacity, soil blowing

- All of the crops suited to the county can be grown in areas of this soil.
- Tilling on the contour or across the slope, chisel plowing, using grassed waterways, and including alfalfa and grasses in the rotation help to control erosion.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing and also collect snow for moisture.

Pasture

Major management factors: Fertility

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 4e
Woodland ordination symbol: 6A
Windbreak suitability group: 6G

1152E—Sugarbush loamy sand, 15 to 30 percent slopes

Composition

Sugarbush soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes on outwash plains and valley trains
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

0 to 2 inches—black loamy sand
2 to 15 inches—brown loamy sand
15 to 22 inches—yellowish brown sandy loam
22 to 60 inches—light brownish yellow, calcareous coarse sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Rapid in the upper part, very rapid in the lower part
Available water capacity: Low
Organic matter content: Low
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat excessively drained Two Inlets soils on side slopes
- The moderately well drained Karlstad soils on hilltops and foot slopes
- The poorly drained Epoufette soils in drainageways

Similar soils:

- Soils that have a surface layer of sandy loam
- Soils that have more clay in the subsoil
- Soils that have less clay in the subsoil
- Soils that have more gravel
- Soils that have numerous cobble- to boulder-sized fragments throughout the profile

Use and Management

Woodland

Major management factors: Erosion hazard, equipment limitations, plant competition

- Careless use of wheeled and tracked equipment disturbs the protective layer of duff.
- Seeding landings, logging areas, and skid roads after the trees are logged helps to establish a protective plant cover.
- Using conventional harvesting methods is difficult because of the slope.
- Because of droughtiness, the competition for moisture is severe.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.
- Poor seedling survival rates during dry years can be improved by careful planting of vigorous nursery stock.

Cropland

Major management factors: Slope

- This soil is generally not suited to crops because of the slope.

Pasture

Major management factors: Slope, fertility

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 6e
Woodland ordination symbol: 6R
Windbreak suitability group: 6G

1200—Egglake loam

Composition

Egglake soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Drainageways and low flat areas on moraines
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 3 to 40 acres

Typical Profile

0 to 4 inches—very dark gray loam
4 to 10 inches—dark grayish brown fine sandy loam
10 to 28 inches—dark grayish brown, mottled sandy clay loam
28 to 60 inches—grayish brown, mottled, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Wykeham soils on foot slopes
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of fine sandy loam
- Soils that have less sand in the substratum

Use and Management

Woodland

Major management factors: Equipment limitations, windthrow hazard, plant competition

- Harvesting is limited to periods when the ground is frozen or dry.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Many trees may be blown down during periods of high winds and excessive wetness.
- If large openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desired species.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Wetness

- All of the crops suited to the county can be grown if adequate drainage is provided.
- Restricting fieldwork during wet periods minimizes surface compaction and helps to maintain tilth.

Pasture

Major management factors: Wetness

- Grazing during wet periods results in compaction of the surface layer and restricts plant growth.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 2w
Woodland ordination symbol: 6W
Windbreak suitability group: 2, drained; 10, undrained

1233D2—Esmond-Heimdal complex, 12 to 20 percent slopes, eroded

Composition

Esmond soil and similar soils: 55 to 80 percent
Heimdal soil and similar soils: 15 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Esmond—shoulder slopes on moraines; Heimdal—side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 50 acres

Typical Profile

Esmond

0 to 5 inches—very dark grayish brown, calcareous loam
5 to 22 inches—yellowish brown, calcareous loam
22 to 60 inches—light olive brown, calcareous loam

Heimdal

0 to 5 inches—very dark gray loam
5 to 11 inches—brown loam
11 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Esmond—moderately low or moderate; Heimdal—moderate or high
Surface runoff: Rapid
Depth to the water table: More than 6 feet
Special characteristics: Moderately eroded or severely eroded in the strongly convex positions

Inclusions

Contrasting inclusions:

- The poorly drained Hedman soils in drainageways and flat areas
- The moderately well drained Fram soils on hilltops and foot slopes
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of sandy loam or fine sandy loam
- Soils that have small seams and pockets of sand or gravel
- Soils that have more clay and less sand

Use and Management

Cropland

Major management factors: Esmond—water erosion, organic matter content, soil blowing, high pH; Heimdal—water erosion

- Small grain and hay are the best suited crops.
- Productivity has been reduced by erosion. Unless the soils are protected, productivity will continue to decline.
- Tilling on the contour or across the slope, using conservation tillage, installing grassed waterways, and including alfalfa and grasses in the rotation help to control erosion.
- Using high-residue crops in a suitable rotation and returning crop residue to the soil help to maintain the content of organic matter.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing.
- Crop varieties that are tolerant of the high pH level should be selected.

Pasture

Major management factors: Fertility, plant competition

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Esmond—7e; Heimdal—4e
Windbreak suitability group: Esmond—8; Heimdal—3

1238E—Two Inlets-Sugarbush complex, 15 to 30 percent slopes

Composition

Two Inlets soil and similar soils: 45 to 60 percent
Sugarbush soil and similar soils: 35 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes on moraines
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

Two Inlets

0 to 2 inches—very dark gray coarse sandy loam
2 to 11 inches—yellowish brown loamy sand
11 to 29 inches—dark yellowish brown gravelly loamy sand
29 to 60 inches—brown, calcareous gravelly coarse sand

Sugarbush

0 to 2 inches—very dark gray coarse sandy loam
2 to 9 inches—yellowish brown loamy coarse sand
9 to 28 inches—dark brown coarse sandy loam
28 to 60 inches—light yellowish brown, calcareous coarse sand

Soil Properties and Qualities

Drainage class: Sugarbush—well drained; Two Inlets—somewhat excessively drained
Permeability: Two Inlets—moderately rapid or rapid in the upper part, rapid or very rapid in the lower part; Sugarbush—moderately rapid or rapid in the upper part, moderately rapid in the next part, very rapid in the lower part
Available water capacity: Low
Organic matter content: Moderately low
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The poorly drained Epoufette soils in drainageways and low areas
- Very poorly drained soils in depressions

Similar soils:

- Soils that have a surface layer of fine sandy loam
- Soils that have more clay in the substratum
- Soils that have numerous cobble- to boulder-sized

fragments throughout the profile

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition

- Using conventional harvesting methods is difficult because of the slope.
- The loose, sandy surface can interfere with the traction of wheeled equipment. Roads should be built on the contour.
- Because of droughtiness, the competition for moisture is severe.
- Adequate site preparation can control initial plant competition, and spraying controls subsequent growth.

Cropland

Major management factors: Slope

- These soils are generally not suited to crops because of the slope.

Pasture

Major management factors: Slope, fertility

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Two Inlets—6s; Sugarbush—6e
Woodland ordination symbol: Two Inlets—6R; Sugarbush—6R
Windbreak suitability group: Two Inlets—7; Sugarbush—6G

1241B—Sandberg sandy loam, 1 to 6 percent slopes

Composition

Sandberg soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Hilltops and side slopes on moraines and outwash plains
Shape of areas: Irregular
Size of areas: 3 to 80 acres

Typical Profile

0 to 10 inches—black sandy loam
10 to 16 inches—dark brown gravelly loamy sand
16 to 46 inches—light yellowish brown, calcareous gravelly sand
46 to 60 inches—pale brown, calcareous sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Moderately rapid or rapid in the upper part, very rapid in the lower part
Available water capacity: Low
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Foldahl soils on plane and slightly convex slopes
- The poorly drained Marysland and Rockwell soils in the lower concave areas

Similar soils:

- Soils that have a surface layer of loamy sand
- Soils that have a substratum of loamy glacial till

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, water erosion

- All of the crops suited to the county can be grown in areas of this soil.
- Using conservation tillage and maintaining crop residue on or near the surface reduce the hazard of erosion and conserve moisture.
- Vegetative barriers, such as windbreaks or grass strips, reduce the hazard of soil blowing and also collect snow for moisture.

Pasture

Major management factors: Fertility, available water capacity, plant competition

- A planned grazing system should be used.
- Applications of fertilizer should be based on the results of soil tests.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 4s
Windbreak suitability group: 7

1804—Hamre muck, ponded

Composition

Hamre soil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Depressions on moraines (fig. 14)
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 5 to 200 acres
Special characteristics: Ponding

Typical Profile

0 to 13 inches—black muck
13 to 19 inches—very dark gray silt loam
19 to 60 inches—grayish brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately slow
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
- The very poorly drained Cathro, Markey, and Haslie soils, which have layers of muck more than 16 inches thick
- The very poorly drained Seelyeville soils, which have layers of muck more than 51 inches thick
- Poorly drained and very poorly drained, mineral soils at the margins of the map unit

Similar soils:
- Soils that have sand below the layer of muck
- Soils that have limnic material below the layer of muck
- Soils that are calcareous at the surface

Use and Management

Woodland

Major management factors: Ponding, wetness
- This soil is not suited to woodland. The ponding restricts the growth of trees.

Cropland

Major management factors: Ponding, wetness
- This soil is not suited to crops because of the ponding during the growing season.

Pasture

Major management factors: Ponding, wetness
- Because of the ponding, only water-tolerant plants, such as cattails, reedgrass, and sedges, can be grown.

Interpretive Groups

Land capability classification: 8w
Windbreak suitability group: 10

1825B—Seelyeville muck, sloping, seep land

Composition

Seelyeville soil and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

Setting

Landform and position on the landform: Gently sloping areas under hydrostatic pressure on moraines and outwash plains
Slope range: 1 to 10 percent
Shape of areas: Irregular
Size of areas: 3 to 80 acres

Typical Profile

0 to 20 inches—very dark gray, calcareous muck
20 to 55 inches—dark olive gray, calcareous muck
55 to 60 inches—dark gray, calcareous muck

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Slow
Seasonal high water table: At the surface to 2 feet below the surface
Special characteristics: Numerous springs and seep spots

Inclusions

Contrasting inclusions:
- Poorly drained and very poorly drained, mineral soils at the margins of the map unit

Similar soils:
- Soils that have a layer of muck less than 51 inches thick

Use and Management

Woodland

Major management factors: Wetness
- Because of wetness and severe seedling mortality, trees are not managed for commercial purposes on this soil.

Cropland

Major management factors: Wetness
- This soil is not suited to crops because of wetness during the growing season.

Pasture

Major management factors: Wetness
- Because of the ponding, only water-tolerant plants, such as cattails, reeds, and sedges, can be grown.

Interpretive Groups

Land capability classification: 6w

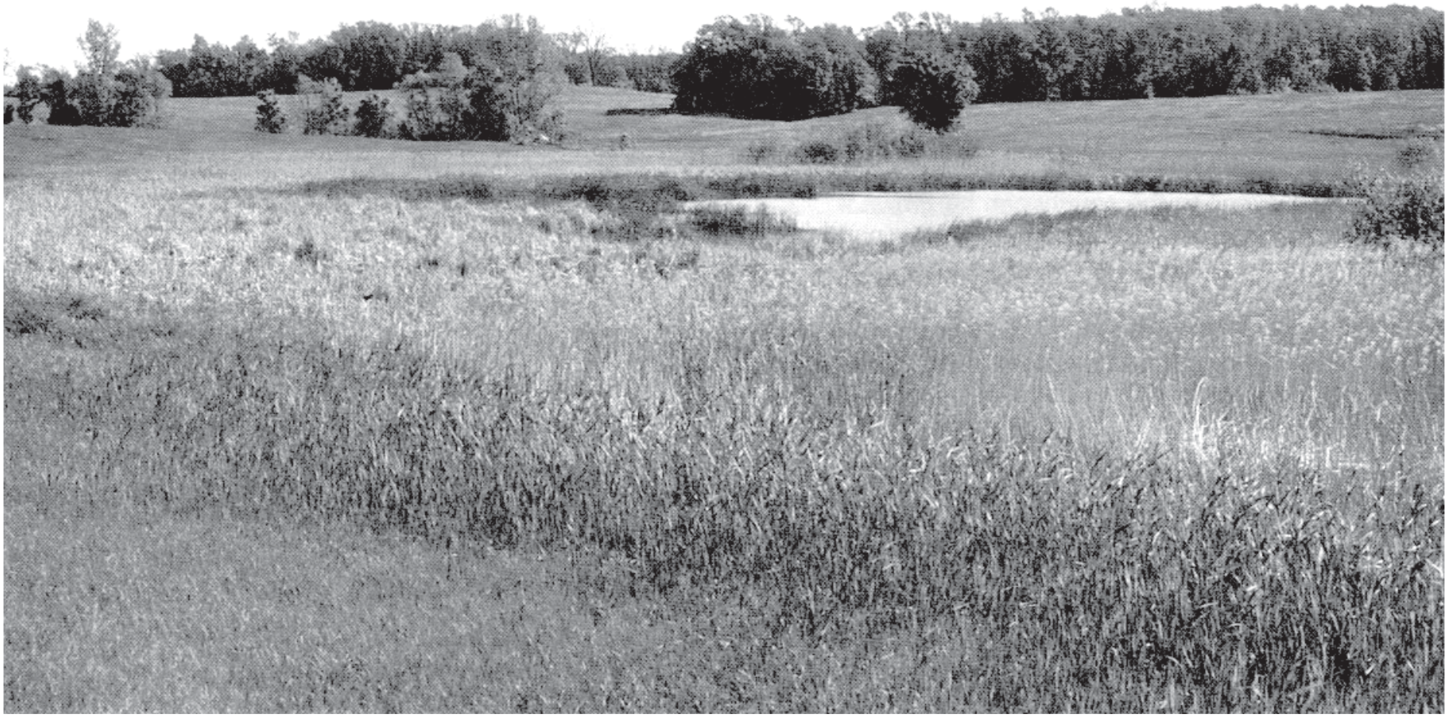

Figure 14.—An area of Hamre muck, ponded. The ponding is a limitation in areas used for pasture.

Windbreak suitability group: 10

1878—Hamre muck

Composition

Hamre soil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Depressions on moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Typical Profile

0 to 14 inches—black muck
14 to 19 inches—black clay loam
19 to 60 inches—grayish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately slow
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained Cathro soils, which have layers of muck more than 16 inches thick
- Poorly drained and very poorly drained, mineral soils at the margins of the map unit

Similar soils:
- Soils that have sand below the layer of muck
- Soils that have limnic material below the layer of muck
- Soils that are calcareous at the surface

Use and Management

Woodland

Major management factors: Wetness
- Because of wetness and severe seedling mortality, trees are not managed for commercial purposes on this soil.

Cropland

Major management factors: Wetness, soil blowing
- Most crops suited to the county can be grown if adequate drainage is provided. Providing drainage is difficult, however, because most areas have poor outlets.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.

Pasture

Major management factors: Wetness
- Only grasses that can tolerate seasonal wetness and periodic ponding, such as reed canarygrass, should be seeded.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 3w, drained; 6w, undrained
Windbreak suitability group: 2W, drained; 10, undrained

1967—Hamerly-Vallers complex

Composition

Hamerly soil and similar soils: 45 to 60 percent
Vallers soil and similar soils: 35 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Hamerly—plane and slightly convex knolls on moraines; Vallers—drainageways, edges of depressions, and low flat areas on moraines
Slope range: Hamerly—1 to 3 percent; Vallers—0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 1,000 acres

Typical Profile

Hamerly

0 to 9 inches—black, calcareous clay loam
9 to 13 inches—grayish brown, calcareous clay loam
13 to 60 inches—light olive brown, mottled, calcareous clay loam

Vallers

0 to 7 inches—black, calcareous silty clay loam
7 to 13 inches—olive gray, calcareous silty clay loam
13 to 20 inches—olive gray, mottled, calcareous clay loam
20 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Hamerly—somewhat poorly drained; Vallers—poorly drained
Permeability: Hamerly—moderate; Vallers—moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Hamerly—medium; Vallers—slow
Depth to the water table: Hamerly—2 to 4 feet; Vallers—1.0 to 2.5 feet

Inclusions

Contrasting inclusions:
- The well drained Barnes and Langhei soils on hilltops and side slopes
- Very poorly drained soils in depressions

Similar soils:
- Soils that have a surface layer of loam or silt loam
- Soils that have a noncalcareous surface layer
- Soils that have small seams and pockets of sand or gravel
- Soils that have less clay and more sand

Use and Management

Cropland

Major management factors: Vallers—wetness, soil blowing, high pH; Hamerly—soil blowing, high pH
- Most of the crops suited to the county can be grown if adequate drainage is provided.
- Crop varieties that are tolerant of the high pH level should be selected.
- Maintaining crop residue on the surface, using conservation tillage, growing a cover crop, and planting field windbreaks reduce the hazard of soil blowing.

Pasture

Major management factors: Plant competition, wetness
- A planned grazing system should be used.
- Grazing during wet periods results in compaction of the surface layer and restricts plant growth.
- Controlling weeds, brush, and excess growth helps to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: Hamerly—2s; Vallers—2w

Windbreak suitability group: Hamerly—1K; Vallers—2K

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 220,000 acres in the survey area, or nearly 60 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the western part, mainly in associations 1, 2, and 3, which are described under the heading "General Soil Map Units." The crops grown on this land are mainly barley and wheat.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Soils that have a seasonal high water table qualify as prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

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Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Natural Resources Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

About two-thirds of the acreage of Mahnomen County is used as cropland. In 1988, the county produced about 65,000 acres of barley, 40,000 acres of wheat, 22,000 acres of mixed hay, 17,000 acres of soybeans, 10,000 acres of corn, and 7,000 acres of oats (Minnesota Agricultural Statistics Service, 1989). Many steeply sloping or excessively wet areas are used for pasture. The productivity of the soils ranges from marginal to high. Good management can increase yields and conserve the soil.

Most of the cropland in the county is subject to water erosion or soil blowing. The hazard of erosion ranges from slight to severe. Sloping soils are the most susceptible to water erosion, and sandy soils that have a high content of free lime at the surface are the most susceptible to soil blowing.

Erosion on cropland is harmful for several reasons. Nutrients and organic matter are lost as the topsoil is removed by erosion. Also, erosion on farmland can result in sedimentation at the base of slopes or in nearby depressions or in pollution of rivers and lakes. Controlling erosion helps to prevent this pollution and maintains the quality of water.

Conservation tillage is one of the most effective erosion-control methods that can be used in the county. A conservation tillage system leaves part or all of the residue from the previous crop on the surface of the soil. Such systems include full-width tillage, chisel plowing or disc or strip tillage, ridge-till, and no-till farming. Conservation tillage helps to control erosion, reduces fuel consumption, and can result in substantial savings of time. Other conservation practices include grassed waterways, water- and sediment-control basins, diversions, and stripcropping. Returning crop residue to the soil increases the rate of water infiltration and thus helps to control runoff and erosion.

Soil blowing can be a problem throughout the county, but it is especially serious in areas of the droughty Sverdrup, Sandberg, and Foldahl soils. Soils that have a high content of lime, such as Fram, Grimstad, and Rockwell soils, are also highly susceptible to soil blowing. Most soil blowing occurs in the fall or early spring when the soil is bare. Leaving crop residue on the surface helps to protect the soil. Leaving fields that were plowed in the fall rough and cloddy can be effective in controlling soil blowing. Establishing field windbreaks and stripcropping also reduce the hazard of soil blowing.

Wetness is a limitation in many low-lying and depressional areas. Artificial drainage minimizes ponding and lowers the water table below the root zone in areas of Flom, Vallers, Urness, Quam, and Rockwell soils. Open ditches drain much of the surface water and provide outlets for subsurface tile lines. If outlets are not available, a pumping station may be required. In wet, sandy soils, however, such as Marysland soils, pumping stations may not be effective because of the rapid permeability of the underlying material. The spacing of subsurface drainage lines depends on the type of soil and the depth at which the drains can be installed. Generally, areas where the soils are finer textured require closer spacing of the lines.

Good soil tilth increases the rate of water infiltration and provides a good seedbed. Working the soils when they are wet can result in surface compaction and can damage soil structure. Moderately fine textured and fine textured soils are frequently tilled in the fall, but the hazard of erosion is high. Ridge planting or chisel plowing reduces the erosion hazard. Freezing and thawing during the winter improve the condition of the surface and make seedbed preparation easier in spring. Returning crop residue to the soil and adding manure improve tilth. A rotation that includes alfalfa and alfalfa-grass mixtures helps to loosen up the soil and improves tilth. Good tilth also helps the soils to warm up faster in the spring and allows for the efficient utilization of nutrients.

On most of the soils in the county, crops respond well to applications of fertilizer. The need for fertilizer depends on the type of soil, past and present management, the degree of erosion, and the kinds of crops to be planted. The kind and amount of fertilizer to be used should be based on the results of soil tests. In areas where there are other limitations, such as droughtiness, excessive wetness, or an imbalance of nutrients caused by a high content of lime, applications of fertilizer may not be as effective. A good fertility management program takes into account all the aspects of plant growth. Soil texture, organic matter content, and soil reaction affect herbicide application rates and the amount of carryover. Detailed information about these soil properties is provided in the section "Detailed Soil Map Units."

The acreage in the county used for pasture has decreased in recent years. The land used for pasture is generally too wet, too steep, or too droughty for use as cropland. Existing pastures can be improved by applying fertilizer, rotating pastures, deferring grazing during wet periods, and controlling weeds. In places the pasture could be renovated by reseeding to more productive species. Drainage conditions and the type of soil should be considered when species are selected for seeding.

The deep, well drained or moderately well drained soils, such as Barnes, Naytahwaush, Waukon, Darnen, and Gonvick soils, are suited to a wide range of plant species, including alfalfa, birdsfoot trefoil, red clover, smooth bromegrass, timothy, orchardgrass, Kentucky bluegrass, and reed canarygrass. Also, these soils are suited to warm-season grasses, such as big bluestem, indiangrass, and switchgrass. All of these cool- and warm-season species are also well adapted to the somewhat poorly drained Hamerly and Fram soils.

Poorly drained and very poorly drained soils, such as Auganaush, Flom, Vallers, Quam, and Hamre soils, are limited to species that are adapted to wet conditions. Adapted species include reed canarygrass, creeping foxtail, redtop, birdsfoot trefoil, alsike clover, and ladino clover. If a drainage system is installed, these soils are also suited to timothy, smooth bromegrass, Kentucky bluegrass, and red clover.

Moderately well drained to excessively drained soils, such as Foldahl, Sandberg, and Menahga soils, typically produce forage in the spring and early summer and again in the fall, if precipitation is adequate. Droughty conditions limit production during the summer. Alfalfa, red clover, birdsfoot trefoil, smooth bromegrass, orchardgrass, timothy, Kentucky bluegrass, and intermediate wheatgrass grow well on these soils if an adequate moisture supply is available. Warm-season grasses, such as big bluestem, little bluestem, indiangrass, switchgrass, and sideoats grama, are also well adapted to these soils. With proper grazing management, these species provide good forage production during the summer and can be used with cool-season species to provide a full-season forage program. Current information on variety selection and adapted species can be obtained from local offices of the Cooperative Extension Service or the Natural Resources Conservation Service.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit (USDA, 1961). Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, 2e. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w, s,* or *c* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of the map units in this survey area is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

About one-third of Mahnomen County, primarily in the eastern part of the county, is woodland. Common tree species in areas on the upland moraine are oak, maple, basswood, aspen, and birch. Common species in the lowland areas are ash, willow, aspen, tamarack, and spruce. Sandy soils, such as those in glacial outwash areas, support jack pine, red pine, birch, and aspen (fig. 15). Oak, aspen, and willow grow along rivers, in wildlife management areas, and on farmsteads in the western part of the county. The timber is used primarily for pulpwood or firewood (fig. 16).

Some wooded areas have recently been logged, are used for pasture, or have been cleared for crops, but there are still tracts of land in the eastern part of the county that could be used for timber production (Jakes and Raile, 1980). Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

Plant competition ratings indicate the degree to which

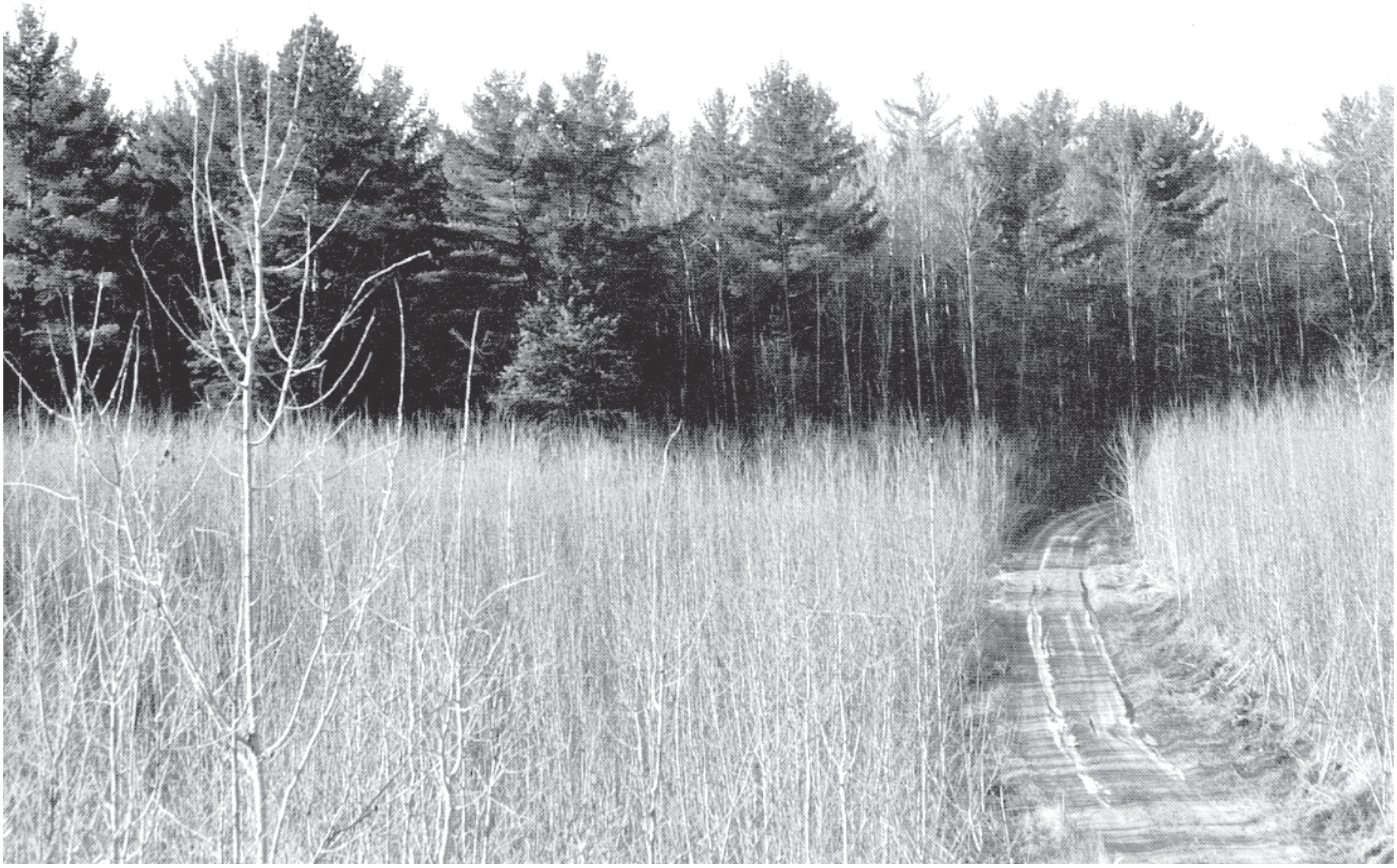

Figure 15.—A mixed stand of pine, aspen, and hardwoods in an area of Sugarbush sandy loam, 1 to 8 percent slopes.

undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are depth to the water table and the available water capacity. A rating of *slight* indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *productivity class.* The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *productivity class*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic meters per hectare per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the

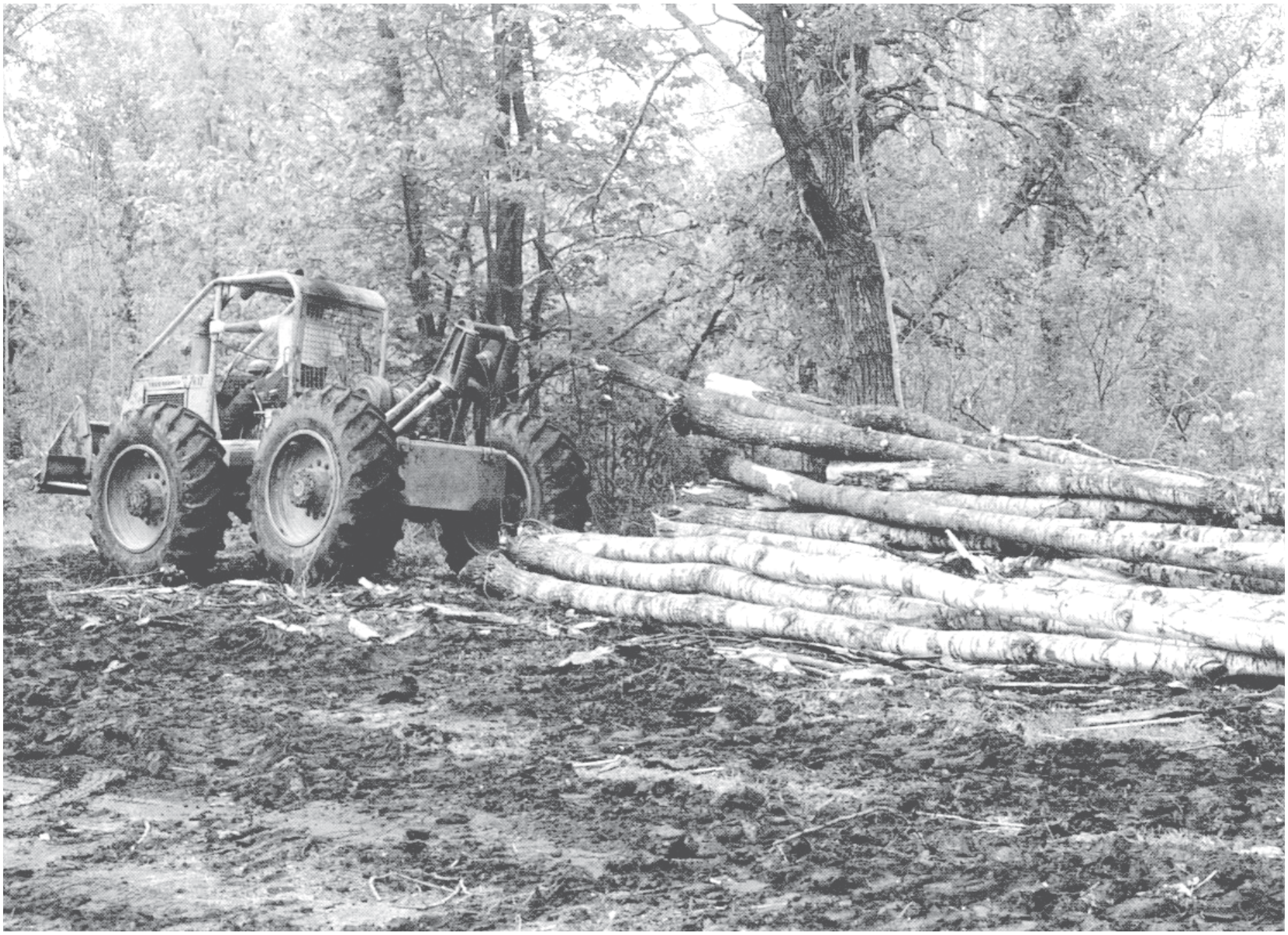

Figure 16.—Timber being harvested for pulpwood.

most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow (fig. 17). They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and

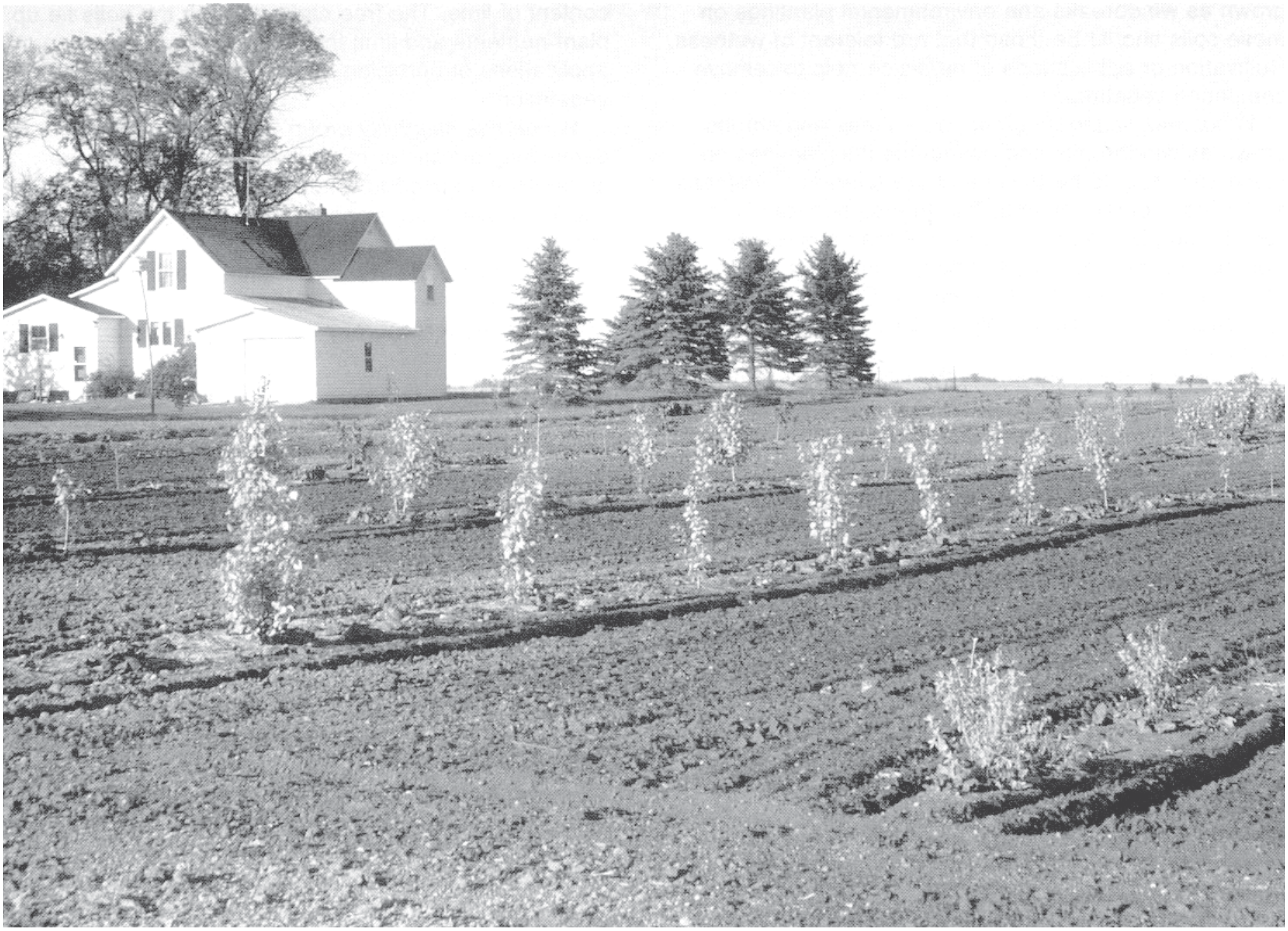

Figure 17.—A windbreak being established on a farmstead.

screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a commercial nursery.

At the end of each description under the heading “Detailed Soil Map Units,” the soil has been assigned to a windbreak suitability group. These groups are based primarily on the suitability of the soil for the locally adapted species, as is indicated by their growth and vigor. Detailed interpretations for each windbreak suitability group in the county are provided in the Technical Guide, which is available in the local office of the Natural Resources Conservation Service.

The soils in Mahnomen County are assigned to 12 different windbreak suitability groups. The paragraphs that follow describe these groups. In areas where the hazard of water erosion is severe, site preparation should be limited to spot treatment extending 2 feet from where a plant is established.

Windbreak suitability group 1.—A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 1K.—Trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of a high content of lime. The free carbonates in the soils tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2.—Trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of wetness. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2K.—Trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of wetness and a high content of lime. The free carbonates in the soils tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is moderate and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2W.—Trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of extreme wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2(O).—Trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of extreme wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 3.—A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 4L.—A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 6G.—Trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of droughty conditions. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 7.—Trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of droughty conditions. Seedling mortality is moderate because of the moisture stress caused by droughtiness. Leaving some vegetation on the surface during the early years of establishment helps to control soil blowing. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 8.—Trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of a high content of lime. The free carbonates in the soils tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 10.—This group consists dominantly of soils or miscellaneous areas that are generally not suited to windbreaks or environmental plantings. Wetness, slope, or restricted available water capacity may limit planting, seedling survival, or the growth of trees and shrubs. Onsite investigation may identify areas where trees and shrubs can be planted. Special management may be needed in these areas.

Recreation

Mahnomen County offers a variety of recreational opportunities because of the diversity of soils, vegetation, and wildlife habitat. The county has large areas of cropland, woodland, and wetlands and has many lakes and streams.

Most of the western part of the county, which was native prairie, is now farmland (Marshner, 1930). Many small tracts of prairie have been preserved and now provide areas where wildflowers, animals, and birds can be observed in their native habitat. The many shallow lakes in this part of the county provide habitat for waterfowl. Most of the wildlife management areas are open to the public for hunting and observation of wildlife.

The eastern part of the county is mostly wooded. It has less farmland than the western part and has more deep lakes. Cabins and resorts are built around most of these lakes. Boating and fishing are the most common recreational activities, but camping, horseback riding, and hiking are also popular. Deer, bear, grouse, and waterfowl are hunted in the fall, and snowmobiling is common in the winter.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Mahnomen County supports a rich variety of wildlife, mainly because of the diversity of landscape and vegetation. The western part of the county, which is mainly prairie, has good potential for deer, moose, red fox, and other furbearers and for prairie chicken, Hungarian partridge, and migratory waterfowl. Intensive agriculture reduces the amount of land available for wildlife habitat, but farmsteads, field windbreaks, and set-aside areas provide some kinds of habitat. The land along rivers and streams also provides habitat for wildlife in agricultural areas. State and Federal wildlife areas have been set aside to provide cover and nesting grounds for wildlife.

The eastern part of the county, which is primarily woodland, supports deer, bear, raccoon, and other furbearers and ruffed grouse, migratory waterfowl, and numerous songbirds. Game fish, such as walleye, northern pike, bass, sunfish, and crappie, are plentiful in the deeper lakes. Soil conservation measures around these lakes minimize the pollution caused by runoff from farmland and thus help to maintain the quality of water. Houses and cabins around the lakes can also cause pollution unless the proper septic system is used. Specifications for septic systems can be obtained from the local office of the Cooperative Extension Service or the Soil and Water Conservation District.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wild rice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations.

For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, and the available water capacity in the upper 40 inches affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, and flooding affect absorption of the effluent. Large stones interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, and rock fragments.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel or stones, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by large stones, slope, and the hazard of cutbanks caving. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones. The performance of a system is affected by the depth of the root zone and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, and large stones affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, and slope affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

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Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

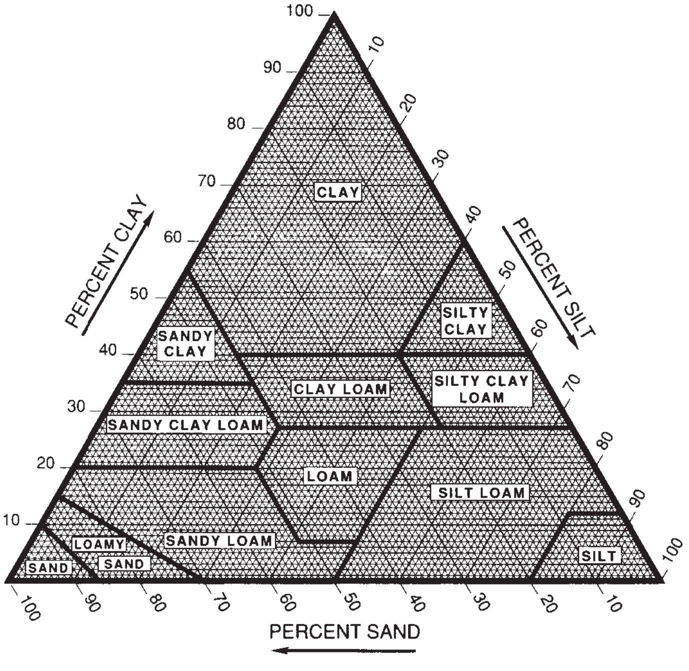

Figure 18.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 18). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 17 shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

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Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1975). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol.* An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu,* meaning water, plus *oll,* from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquolls (*Hapl,* meaning minimal horizonation, plus *aquoll,* the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, frigid Typic Haplaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). Unless otherwise stated, matrix colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Auganaush Series

Drainage class: Poorly drained
Permeability: Moderate in the upper part, slow in the next part, moderately slow or slow in the lower part

Landform: Moraines
Parent material: Glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine, mixed, frigid Mollic Ochraqualfs

Typical Pedon

Auganaush loam, 2,120 feet north and 500 feet east of the southwest corner of sec. 35, T. 144 N., R. 40 W.

A—0 to 5 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; many fine roots; 1 percent gravel; slightly acid; clear wavy boundary.

E—5 to 8 inches; dark grayish brown (2.5Y 4/2) loam, gray (10YR 5/1) dry; common medium distinct dark olive gray (5Y 3/2) mottles; weak fine subangular blocky structure; friable; many fine roots; 1 percent gravel; moderately acid; clear irregular boundary.

Btg1—8 to 17 inches; grayish brown (2.5Y 5/2) clay; common fine distinct olive (5Y 5/3) mottles; moderate medium subangular blocky structure; very firm; common medium roots; common distinct very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in pores; 1 percent gravel; slightly acid; gradual wavy boundary.

Btg2—17 to 22 inches; olive gray (5Y 5/2) silty clay loam; few medium distinct light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; firm; few medium roots; common distinct very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in pores; 2 percent gravel; neutral; gradual wavy boundary.

Btg3—22 to 38 inches; olive gray (5Y 5/2) silty clay loam; common medium prominent light olive brown (2.5Y 5/6) mottles; weak medium subangular blocky structure; firm; few medium roots; few distinct very dark grayish brown (2.5Y 3/2) clay films in pores; slight effervescence; neutral; 2 percent gravel; clear wavy boundary.

Cg—38 to 60 inches; light olive gray (5Y 6/2) silty clay loam; common medium distinct light olive brown (2.5Y 5/4) and few fine distinct olive (5Y 5/4) mottles; massive; firm; 3 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to 40 inches
Content of rock fragments: 1 to 8 percent throughout the profile

A horizon:
Hue—2.5Y, 10YR, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—loam

E horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam, silt loam, or fine sandy loam

Btg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay, silty clay, silty clay loam, or clay loam

Cg horizon:
Hue—5Y or 2.5Y
Value—5 to 7
Chroma—1 or 2
Texture—silty clay loam, clay loam, or silty clay

Barnes Series

Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 2 to 20 percent
Taxonomic class: Fine-loamy, mixed Udic Haploborolls

Typical Pedon

Barnes loam, 2 to 6 percent slopes, 2,450 feet west and 150 feet south of the northeast corner of sec. 19, T. 144 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common fine roots; 1 percent gravel; slightly alkaline; abrupt smooth boundary.

Bw—9 to 15 inches; dark brown (10YR 4/3) loam; moderate fine subangular blocky structure; friable; few fine roots; 3 percent gravel; slightly alkaline; clear wavy boundary.

Bk—15 to 33 inches; yellowish brown (10YR 5/4) loam; moderate medium subangular blocky structure; friable; 3 percent gravel; common white (2.5Y 8/2) carbonate coatings on faces of peds; few soft white (2.5Y 8/2) threads and masses of carbonates; violent effervescence; moderately alkaline; gradual wavy boundary.

C—33 to 60 inches; light yellowish brown (10YR 6/4) loam; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 10 to 18 inches
Thickness of the mollic epipedon: 7 to 12 inches

Content of rock fragments: 1 to 10 percent throughout the profile

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—loam

Bw horizon:
Hue—10YR or 2.5Y
Value—2 to 5
Chroma—2 to 4
Texture—loam

Bk horizon:
Hue—2.5Y or 10YR
Value—4 to 6
Chroma—2 to 4
Texture—loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam

Beltrami Series

Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Beltrami loam, 300 feet north and 1,900 feet east of the southwest corner of sec. 22, T. 143 N., R. 40 W.

A—0 to 4 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many medium roots; 3 percent gravel; neutral; clear wavy boundary.

E—4 to 9 inches; grayish brown (10YR 5/2) loam; weak thin platy structure; friable; common medium roots; 3 percent gravel; neutral; clear wavy boundary.

Bt1—9 to 21 inches; yellowish brown (10YR 5/4) clay loam; few fine distinct dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; firm; common medium roots; common distinct dark grayish brown (10YR 3/2) clay films on faces of peds; 3 percent gravel; slightly acid; gradual wavy boundary.

Bt2—21 to 32 inches; brown (10YR 5/3) clay loam; few fine distinct yellowish brown (10YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; strong medium angular blocky structure; firm; common medium roots; many distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; 3 percent gravel; slightly acid; clear wavy boundary.

Bt3—32 to 36 inches; light olive brown (2.5Y 5/4) clay loam; common fine distinct strong brown (7.5YR 5/6) and few fine distinct light brownish gray (2.5Y 6/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; few prominent very dark grayish brown (10YR 3/2) clay films on faces of peds; 5 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

C—36 to 60 inches; light yellowish brown (2.5Y 6/4) loam; common fine distinct strong brown (7.5YR 5/6) and few fine distinct light brownish gray (2.5Y 6/2) mottles; massive; friable; few fine roots; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 22 to 40 inches
Content of rock fragments: 2 to 10 percent throughout the profile

A horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—loam

E horizon:
Hue—10YR
Value—4 to 6
Chroma—1 or 2
Texture—loam or fine sandy loam

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—loam or clay loam

Cathro Series

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part, moderately slow or moderate in the lower part
Landform: Moraines
Parent material: Organic material over glacial till
Slope range: 0 to 1 percent

Taxonomic class: Loamy, mixed, euic Terric Borosaprists

Typical Pedon

Cathro muck, 1,500 feet south and 500 feet west of the northeast corner of sec. 16, T. 146 N., R. 41 W.

Oa1—0 to 15 inches; muck, black (5YR 2/1) rubbed and pressed; weak fine granular structure; common fine and medium roots; about 35 percent fiber unrubbed, 15 percent rubbed; mostly herbaceous fiber; neutral; clear smooth boundary.

Oa2—15 to 24 inches; muck, black (N 2/0) broken faced and rubbed; moderate medium subangular blocky structure parting to weak fine granular; common very fine and fine roots; about 30 percent fiber unrubbed, less than 10 percent rubbed; mostly herbaceous fiber; neutral; abrupt smooth boundary.

Cg1—24 to 36 inches; light brownish gray (2.5Y 6/2) loam; common fine distinct gray (10YR 6/1) and few fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; few very fine roots; 4 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg2—36 to 60 inches; gray (5Y 5/1) loam; common medium distinct strong brown (7.5YR 5/6) mottles; massive; friable; 5 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches
Depth to carbonates: 16 to 51 inches

Oa horizon:
Hue—10YR, 7.5YR, 5YR, or neutral
Value—2 or 3
Chroma—0 to 3
Texture—muck

Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 to 3
Texture—loam, clay loam, silty clay loam, or fine sandy loam
Content of rock fragments—1 to 15 percent

Colvin Series

Drainage class: Poorly drained
Permeability: Moderately slow or moderate
Landform: Outwash channels and low stream terraces
Parent material: Silty glacial sediments
Slope range: 0 to 1 percent
Taxonomic class: Fine-silty, frigid Typic Calciaquolls

Typical Pedon

Colvin silt loam, occasionally flooded, 1,000 feet east and 300 feet south of the northwest corner of sec. 4, T. 146 N., R. 42 W.

A—0 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak moderate granular structure; friable; many fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

Bkg1—9 to 21 inches; gray (5Y 5/1) silt loam; weak moderate subangular blocky structure; friable; common soft white (2.5Y 8/2) accumulations of carbonates; violent effervescence; moderately alkaline; clear wavy boundary.

Bkg2—21 to 28 inches; light brownish gray (2.5Y 6/2) silt loam; common fine prominent olive yellow (2.5Y 6/6) and few medium distinct light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; friable; common soft white (2.5Y 8/2) accumulations of carbonates; violent effervescence; moderately alkaline; clear wavy boundary.

Cg1—28 to 52 inches; olive (5Y 5/3) silt loam; common fine distinct light olive brown (2.5Y 5/4) and few fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg2—52 to 60 inches; pale olive (5Y 6/3) very fine sandy loam; common fine distinct light yellowish brown (2.5Y 6/4) and few fine distinct gray (5Y 5/1) mottles; massive; very friable; slight effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 20 inches

A horizon:
Hue—2.5Y, 10YR, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silt loam

Bk horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 7
Chroma—0 to 2
Texture—silty clay loam or silt loam

Cg horizon:
Hue—5Y or 2.5Y
Value—3 to 6
Chroma—1 to 4
Texture—silt loam, silty clay loam, sandy clay loam, very fine sandy loam, or sandy loam

Darnen Series

Drainage class: Well drained

Permeability: Moderate
Landform: Moraines
Parent material: Colluvial material over glacial till
Slope range: 2 to 6 percent
Taxonomic class: Fine-loamy, mixed Pachic Udic Haploborolls

Typical Pedon

Darnen loam, 2 to 6 percent slopes, 300 feet west and 2,000 feet south of the northeast corner of sec. 9, T. 144 N., R. 41 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.

A—10 to 28 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; few fine roots; 1 percent gravel; neutral; clear wavy boundary.

Bw1—28 to 38 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; few fine roots; 2 percent gravel; neutral; gradual wavy boundary.

Bw2—38 to 47 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (2.5Y 4/2) loam; weak fine subangular blocky structure; friable; 4 percent gravel; strong effervescence; slightly alkaline; gradual wavy boundary.

C—47 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; 4 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of the mollic epipedon: 24 to 48 inches
Content of rock fragments: 0 to 5 percent throughout the profile

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—2.5Y
Value—4 to 6
Chroma—2 to 6
Texture—loam or clay loam

Egglake Series

Drainage class: Poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, frigid Mollic Ochraqualfs

Typical Pedon

Egglake loam, 1,750 feet north and 2,000 feet west of the southeast corner of sec. 35, T. 143 N., R. 39 W.

A—0 to 4 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; many fine roots; 2 percent gravel; slightly acid; clear wavy boundary.

E—4 to 10 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; common fine roots; 2 percent gravel; neutral; gradual wavy boundary.

Btg—10 to 28 inches; dark grayish brown (2.5Y 4/2) sandy clay loam; common medium prominent yellowish red (5YR 4/6) and few fine distinct olive brown (2.5Y 4/4) mottles; weak medium subangular blocky structure; friable; few medium roots; few faint dark gray (2.5Y 4/1) clay films on faces of peds and in pores; 5 percent gravel; neutral; gradual wavy boundary.

Cg—28 to 60 inches; grayish brown (2.5Y 5/2) sandy loam; common fine prominent brownish yellow (10YR 6/6) and few fine faint light brownish gray (2.5Y 6/2) mottles; massive; friable; 8 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Content of rock fragments: 2 to 10 percent throughout the profile

A horizon:
Hue—2.5Y or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—loam

E horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—fine sandy loam or sandy loam

Btg horizon:
Hue—5Y or 2.5Y
Value—4 to 6
Chroma—1 or 2

Texture—sandy clay loam, loam, or sandy loam

Cg horizon:
Hue—5Y or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—sandy loam or coarse sandy loam

Epoufette Series

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part, very rapid in the lower part
Landform: Outwash plains
Parent material: Glacial outwash
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy, mixed, frigid Mollic Ochraqualfs

Typical Pedon

Epoufette sandy loam, 1,780 feet north and 400 feet west of the southeast corner of sec. 8, T. 143 N., R. 39 W.

A—0 to 9 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; common fine roots; 2 percent gravel; neutral; gradual wavy boundary.

Eg—9 to 27 inches; dark grayish brown (2.5Y 4/2) sand; common fine distinct light yellowish brown (2.5Y 6/4) and medium yellowish brown (10YR 5/6) mottles; single grain; loose; common fine roots; 5 percent gravel; neutral; clear wavy boundary.

Btg—27 to 35 inches; dark grayish brown (2.5Y 4/2) sandy loam; common medium distinct light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; few fine roots; common clay bridges between sand grains; 5 percent gravel; neutral; clear wavy boundary.

Cg—35 to 60 inches; grayish brown (2.5Y 5/2) gravelly sand; common fine distinct light yellowish brown (2.5Y 6/4) mottles; single grain; loose; 15 percent gravel; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam
Content of rock fragments—0 to 15 percent

Eg horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—sand, loamy sand, or gravelly loamy sand
Content of rock fragments—5 to 15 percent

Btg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—sandy loam or gravelly loamy sand
Content of rock fragments—5 to 20 percent

Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 or 6
Chroma—2 or 3
Texture—sand, coarse sand, or the gravelly analogs of these textures
Content of rock fragments—10 to 35 percent

Esmond Series

Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 3 to 20 percent
Taxonomic class: Coarse-loamy, mixed Udorthentic Haploborolls

Typical Pedon

Esmond loam, in an area of Heimdal-Esmond complex, 6 to 12 percent slopes, eroded, 1,400 feet west and 100 feet north of the southeast corner of sec. 18, T. 146 N., R. 42 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine granular structure; friable; common fine roots; 2 percent gravel; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bk—8 to 24 inches; light yellowish brown (10YR 6/4) loam; weak fine and medium subangular blocky structure; friable; few fine roots; common soft white (2.5Y 8/2) threads and masses of carbonates; 3 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

C—24 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 8 inches
Thickness of the mollic epipedon: 4 to 10 inches
Content of rock fragments: 1 to 10 percent throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam, sandy loam, fine sandy loam

C horizon:
Hue—2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—loam, sandy loam, fine sandy loam

Fairdale Series

Drainage class: Moderately well drained
Permeability: Moderate
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 3 percent
Taxonomic class: Fine-loamy, mixed (calcareous), frigid Mollic Udifluvents

Typical Pedon

Fairdale loam, in an area of Fairdale and Lamoure soils, occasionally flooded, 180 feet south and 90 feet east of the northwest corner of sec. 31, T. 145 N., R. 40 W.

A—0 to 7 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; common fine roots; very slight effervescence; slightly alkaline; clear wavy boundary.

C1—7 to 14 inches; dark grayish brown (10YR 4/2) loam; weak medium subangular blocky structure; friable; few fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

C2—14 to 22 inches; dark grayish brown (2.5Y 4/2) silt loam; massive; friable; few very fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

C3—22 to 28 inches; grayish brown (2.5Y 5/2) very fine sandy loam; few medium prominent brownish yellow (10YR 6/6) mottles; massive; friable; violent effervescence; moderately alkaline; clear wavy boundary.

C4—28 to 34 inches; very dark gray (10YR 3/1) and grayish brown (2.5Y 5/2) loam; few medium distinct olive brown (2.5Y 4/4) mottles; massive; friable; strong effervescence; moderately alkaline; clear wavy boundary.

C5—34 to 46 inches; grayish brown (2.5Y 5/2) fine sandy loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; massive; strong effervescence; moderately alkaline; clear wavy boundary.

C6—46 to 60 inches; grayish brown (2.5Y 5/2) loam; common fine distinct olive brown (2.5Y 4/4) and prominent dark yellowish brown (10YR 4/6) mottles; massive; few threads of lime; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—loam

C horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—1 to 3
Texture—loam and silt loam with strata of silty clay loam, fine sandy loam, or very fine sandy loam

Flom Series

Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, frigid Typic Haplaquolls

Typical Pedon

Flom silty clay loam, 1,200 feet north and 2,600 feet east of the southwest corner of sec. 17, T. 143 N., R. 42 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; many fine roots; 1 percent gravel; neutral; abrupt smooth boundary.

ABg—10 to 15 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (2.5Y 4/2) clay loam; weak fine subangular blocky structure; friable; few fine roots; 2 percent gravel; neutral; gradual wavy boundary.

Bg—15 to 20 inches; dark grayish brown (2.5Y 4/2) clay loam; common fine distinct light olive brown (2.5Y 4/4) mottles; moderate fine subangular blocky structure; friable; few fine roots; few strong brown (7.5YR 5/8) iron stains; 2 percent gravel; slightly alkaline; gradual wavy boundary.

Bkg—20 to 38 inches; grayish brown (2.5Y 5/2) loam; many medium distinct light olive brown (2.5Y 5/4) and few fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; few soft white (2.5Y 8/2) masses of carbonates; few strong brown (7.5YR 5/8) iron stains; 5 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg—38 to 60 inches; light olive brown (2.5Y 5/2) loam; common fine distinct light brownish gray (2.5Y 5/4) and common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 14 to 30 inches

Thickness of the mollic epipedon: 10 to 24 inches

Content of rock fragments: 1 to 10 percent throughout the profile

A horizon:

Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam

ABg horizon:

Colors—similar to those of the A and Bg horizons
Textures—similar to those of the A and Bg horizons

Bg horizon:

Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam, loam, or silty clay loam

Bkg horizon:

Hue—2.5Y or 5Y
Value—4 or 5
Chroma—2 or 3
Texture—clay loam or loam

Cg horizon:

Hue—2.5Y or 5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam or clay loam

Foldahl Series

Drainage class: Moderately well drained

Permeability: Rapid in the upper part, moderately slow or moderate in the lower part

Landform: Glacial lake plains

Parent material: Sandy lacustrine sediments over glacial till

Slope range: 1 to 3 percent

Taxonomic class: Sandy over loamy, mixed Aquic Haploborolls

Typical Pedon

Foldahl sandy loam, 2,400 feet east and 2,150 feet north of the southwest corner of sec. 28, T. 145 N., R. 41 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; few medium roots; neutral; abrupt smooth boundary.

Bw1—8 to 15 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; few medium roots; neutral; clear wavy boundary.

Bw2—15 to 22 inches; dark grayish brown (10YR 4/2) loamy sand; weak fine subangular blocky structure; very friable; few fine roots; neutral; clear wavy boundary.

C1—22 to 30 inches; yellowish brown (10YR 5/4) fine sand; few fine distinct brownish yellow (10YR 6/8) and faint pale brown (10YR 6/3) mottles; single grain; loose; few fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

2C2—30 to 42 inches; light olive brown (2.5Y 5/4) loam; common medium distinct light brownish gray (2.5Y 6/2) and brownish yellow (10YR 6/8) mottles; massive; friable; 2 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

2C3—42 to 60 inches; light olive brown (2.5Y 5/4) loam; common fine faint grayish brown (2.5Y 5/2) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the upper sandy sediments: 20 to 40 inches

Depth to carbonates: 16 to 24 inches

Thickness of the mollic epipedon: 7 to 16 inches

A horizon:

Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam
Content of rock fragments—0 to 8 percent

Bw horizon:

Hue—10YR
Value—3 or 4
Chroma—2 to 4
Texture—sand, loamy sand, or loamy fine sand
Content of rock fragments—0 to 8 percent

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—sand, loamy sand, fine sand, or loamy fine sand
Content of rock fragments—0 to 8 percent

2C horizon:
Hue—10YR or 2.5Y
Value—5 to 7
Chroma—2 to 4
Texture—sandy loam, loam, or clay loam
Content of rock fragments—2 to 15 percent

Fordum Series

Drainage class: Poorly drained
Permeability: Moderate or moderately rapid in the upper part, rapid or very rapid in the lower part
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy, mixed, nonacid, frigid Mollic Fluvaquents
Taxadjunct features: The Fordum soils in Mahnomen County have carbonates closer to the surface than is defined as the range for the series. They are classified as coarse-loamy, mixed (calcareous), frigid Mollic Fluvaquents.

Typical Pedon

Fordum loam, in an area of Fordum, Fairdale, and Lamoure soils, frequently flooded, 1,250 feet east and 600 feet south of the northwest corner of sec. 3, T. 145 N., R. 42 W.

A—0 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR4/1) dry; moderate fine granular structure; friable; common fine roots; neutral; clear wavy boundary.

Cg1—9 to 25 inches; very dark grayish brown (2.5Y 3/2) very fine sandy loam; few fine distinct grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; friable; few fine roots; slight effervescence; moderately alkaline; abrupt smooth boundary.

Cg2—25 to 30 inches; brown (10YR 5/3) loamy sand; few fine faint grayish brown (2.5Y 5/2) mottles; massive; very friable; 2 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

Cg3—30 to 38 inches; very dark grayish brown (10YR 3/2) fine sandy loam; common fine faint dark grayish brown (2.5Y 4/2) and few fine prominent yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; very friable; 2 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

Cg4—38 to 60 inches; grayish brown (10YR 5/2) sand; common fine prominent brownish yellow (10YR 6/6) mottles; single grain; loose; 10 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 6 to 9 inches
Content of rock fragments: 0 to 35 percent, predominantly in the 2C horizon

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 3
Texture—loam

Cg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral in the upper part; 10YR or 7.5YR in the lower part
Value—3 to 5 in the upper part, 4 to 6 in the lower part
Chroma—0 to 3 in the upper part, 1 to 4 in the lower part
Texture—loam, very fine sandy loam, sandy loam, fine sand, or silt loam in the upper part; sand, fine sand, loamy fine sand, loamy sand, or the gravelly analogs of these textures in the lower part

Fram Series

Drainage class: Moderately well drained or somewhat poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 1 to 3 percent
Taxonomic class: Coarse-loamy, frigid Aeric Calciaquolls

Typical Pedon

Fram loam, 2,500 feet north and 450 feet west of the southeast corner of sec. 12, T. 146 N., R. 42 W.

A—0 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; many fine roots; 1 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

Bk—12 to 19 inches; dark grayish brown (2.5Y 4/2) fine sandy loam; weak fine subangular blocky structure; friable; common fine roots; many soft white (2.5Y

8/2) threads and masses of carbonates; 5 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

C—19 to 60 inches; light olive brown (2.5Y 5/4) loam; many medium prominent light gray (5Y 7/2) mottles; massive; friable; few strong brown (7.5YR 5/8) iron stains; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 1 to 10 percent throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—fine sandy loam, sandy loam, or loam

C horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—sandy loam, fine sandy loam, or loam

Gonvick Series

Drainage class: Moderately well drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed Aquic Argiborolls

Typical Pedon

Gonvick loam, 1,700 feet east and 150 feet north of the southwest corner of sec. 34, T. 146 N., R. 40 W.

A—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common fine roots; 2 percent gravel; neutral; clear wavy boundary.

Bt1—10 to 17 inches; dark grayish brown (2.5Y 4/2) clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; 2 percent gravel; neutral; clear wavy boundary.

Bt2—17 to 25 inches; olive brown (2.5Y 4/4) clay loam; few medium distinct dark grayish brown (2.5Y 4/2) mottles; moderate medium subangular blocky structure; firm; few very fine roots; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; 3 percent gravel; neutral; gradual wavy boundary.

C—25 to 60 inches; light olive brown (2.5Y 5/4) loam; common medium distinct light brownish gray (2.5Y 6/2) mottles; massive; friable; few very fine roots; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 22 to 30 inches
Thickness of the mollic epipedon: 8 to 16 inches
Content of rock fragments: 2 to 8 percent throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—loam

Bt horizon:
Hue—2.5Y or 10YR
Value—4 or 5
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—loam or clay loam

Graycalm Series

Drainage class: Somewhat excessively drained
Permeability: Rapid
Landform: Outwash plains and moraines
Parent material: Glacial outwash
Slope range: 1 to 8 percent
Taxonomic class: Mixed, frigid Argic Udipsamments

Typical Pedon

Graycalm loamy sand, in an area of Graycalm-Menahga complex, 1 to 8 percent slopes, 550 feet east and 100 feet south of the northwest corner of sec. 16, T. 143 N., R. 39 W.

A—0 to 2 inches; very dark brown (10YR 2/2) loamy sand; weak fine granular structure; very friable; many fine roots; moderately acid; clear wavy boundary.

Bw—2 to 9 inches; yellowish brown (10YR 5/4) loamy sand; weak medium granular structure; very friable; common fine roots; 1 percent gravel; moderately acid; gradual wavy boundary.

E—9 to 18 inches; brown (10YR 5/3) sand; single grain; very friable; few fine roots; 5 percent gravel; moderately acid; clear wavy boundary.

E&Bt—18 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; lamellae and bands of dark brown (7.5YR 4/4) sandy loam; weak very fine subangular blocky structure; friable; bands are ⅛ to ½ inch thick with a total thickness of 3 inches; 2 percent gravel; slightly acid.

Range in Characteristics

Depth to carbonates: 40 to 60 inches
Content of rock fragments: 0 to 15 percent throughout the profile

A horizon:
Hue—10YR or 7.5YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy sand

Bw horizon:
Hue—10YR or 7.5YR
Value—3 to 6
Chroma—4 to 6
Texture—loamy sand or sand

E horizon:
Hue—10YR or 7.5YR
Value—5 or 6
Chroma—2 to 4
Texture—sand or loamy sand

Bt part of the E&Bt horizon:
Hue—7.5YR or 10YR
Value—3 to 6
Chroma—4 to 6
Thickness of bands—1⁄16 inch to 2 inches; total thickness of loamy bands less than 3 inches, total thickness of sandy bands less than 6 inches
Texture—sandy loam, loamy sand, or fine sandy loam

Grimstad Series

Drainage class: Somewhat poorly drained
Permeability: Moderately rapid in the upper part, rapid in the next part, moderate in the lower part
Landform: Moraines
Parent material: Outwash sediments over glacial till
Slope range: 0 to 3 percent
Taxonomic class: Sandy over loamy, frigid Aeric Calciaquolls

Typical Pedon

Grimstad sandy loam, 2,000 feet east and 300 feet north of the southwest corner of sec. 22, T. 146 N., R. 41 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common fine roots; strong effervescence; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 13 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak very fine subangular blocky structure; friable; few fine roots; many soft white (2.5Y 8/2) threads and masses of carbonates; strong effervescence; moderately alkaline; clear wavy boundary.

Bk2—13 to 21 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; weak fine granular structure; very friable; few fine roots; common soft white (2.5Y 8/2) threads and masses of carbonates; strong effervescence; moderately alkaline; clear wavy boundary.

Bk3—21 to 32 inches; light olive brown (2.5Y 5/4) loamy fine sand; common fine faint light yellowish brown (2.5Y 6/4) mottles; weak very fine subangular blocky structure; very friable; few fine roots; common soft white (2.5Y 8/2) threads and masses of carbonates; strong effervescence; moderately alkaline; clear smooth boundary.

C1—32 to 39 inches; grayish brown (2.5Y 5/2) loamy fine sand; common medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; 2 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

2C2—39 to 60 inches; grayish brown (2.5Y 5/2) loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; friable; 3 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 12 inches
Thickness of the upper mantle: 20 to 40 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam

Bk horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—1 to 4
Texture—fine sandy loam, loamy sand, or loamy fine sand

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—sand, fine sand, or loamy fine sand

2C horizon:
Hue—2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—fine sandy loam, loam, silt loam, or clay loam
Content of rock fragments—1 to 10 percent

Hamerly Series

Drainage class: Moderately well drained or somewhat poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, frigid Aeric Calciaquolls

Typical Pedon

Hamerly clay loam, 1,200 feet north and 100 feet east of the southwest corner of sec. 36, T. 145 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common fine roots; 1 percent gravel; strong effervescence; moderately alkaline; abrupt smooth boundary.

ABk—9 to 13 inches; very dark grayish brown (2.5Y 3/2) clay loam, grayish brown (2.5Y 5/2) dry; weak fine subangular blocky structure; friable; common very fine roots; common soft white (2.5Y 8/2) threads and masses of carbonates; 3 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

Bk—13 to 23 inches; light olive brown (2.5Y 5/4) loam; few fine distinct yellowish brown (10YR 5/6) and few fine distinct light olive gray (5Y 6/2) mottles; weak medium subangular blocky structure; friable; common very fine roots; many soft white (2.5Y 8/2) threads and masses of carbonates; 3 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

C1—23 to 36 inches; light olive brown (2.5Y 5/4) loam; common medium distinct light olive gray (5Y 6/2) and common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; few very fine roots; few strong brown (7.5YR 5/6) iron stains; 3 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

C2—36 to 60 inches; light olive brown (2.5Y 5/4) loam; many large distinct light olive gray (5Y 6/2) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; few strong brown (7.5YR 5/6) iron stains; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 1 to 10 percent throughout the profile

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—clay loam

ABk horizon:
Colors—similar to those of the A and Bk horizons
Textures—similar to those of the A and Bk horizons

Bk horizon:
Hue—10YR or 2.5Y
Value—3 to 7
Chroma—1 to 4
Texture—clay loam or loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 to 4
Texture—clay loam or loam

Hamlet Series

Drainage class: Moderately well drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed Aquic Haploborolls

Typical Pedon

Hamlet loam, 1,400 feet north and 450 feet east of the southwest corner of sec. 17, T. 143 N., R. 42 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; many fine roots; 1 percent gravel; neutral; abrupt smooth boundary.

A—8 to 12 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; many fine roots; 1 percent gravel; neutral; clear wavy boundary.

Bw1—12 to 17 inches; dark grayish brown (2.5Y 4/2) loam; weak fine subangular blocky structure; friable;

few fine roots; 2 percent gravel; slightly alkaline; gradual wavy boundary.

Bw2—17 to 20 inches; olive brown (2.5Y 4/4) loam; few fine distinct grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; friable; few fine roots; 2 percent gravel; slightly alkaline; gradual wavy boundary.

Bk—20 to 35 inches; light yellowish brown (2.5Y 6/4) loam; common fine distinct light brownish gray (2.5Y 6/2) mottles; weak medium subangular blocky structure; friable; common soft white (2.5Y 8/2) threads and masses of carbonates; 5 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

C—35 to 60 inches; light olive brown (2.5Y 5/4) loam; common medium distinct light brownish gray (2.5Y 6/2) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 14 to 24 inches
Thickness of the mollic epipedon: 9 to 16 inches
Content of rock fragments: 1 to 8 percent throughout the profile

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—loam

Bw horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam or clay loam

Bk horizon:
Hue—2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam or clay loam

Hamre Series

Drainage class: Very poorly drained
Permeability: Moderate or moderately slow
Landform: Moraines
Parent material: Organic material and glacial till
Slope range: 0 to 1 percent
Taxonomic class: Fine-loamy, mixed, nonacid, frigid Histic Humaquepts

Typical Pedon

Hamre muck, 2,100 feet west and 500 feet north of the southeast corner of sec. 1, T. 143 N., R. 42 W.

Oa—0 to 14 inches; muck, black (N 2/0) broken face and rubbed; about 15 percent fiber unrubbed, less than 5 percent rubbed; weak fine granular structure; very friable; many fine and medium roots; mostly herbaceous fiber; neutral; clear smooth boundary.

A—14 to 19 inches; black (N 2/0) clay loam; weak medium subangular blocky structure; friable; many fine roots; 2 percent gravel; neutral; clear wavy boundary.

Bg—19 to 60 inches; grayish brown (2.5Y 5/2) clay loam; many coarse distinct light olive brown and few medium prominent strong brown (7.5YR 5/8) mottles; weak very fine subangular blocky structure; friable; few fine roots; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 12 to 25 inches
Thickness of the organic material: 8 to 16 inches

Oa horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—muck

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—silt loam, loam, clay loam, and the mucky analogs of these textures
Content of rock fragments—1 to 15 percent

Bg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam or clay loam
Content of rock fragments—1 to 15 percent

Haslie Series

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid in the upper part, slow in the lower part
Landform: Moraines and outwash plains
Parent material: Organic material over coprogenous earth (sedimentary peat)
Slope range: 0 to 1 percent

Taxonomic class: Coprogenous, euic Limnic Borosaprists

Typical Pedon

Haslie muck, 1,500 feet west and 200 feet north of the southeast corner of sec. 30, T. 144 N., R. 42 W.

Oa1—0 to 4 inches; muck, black (10YR 2/1) broken face; weak fine granular structure; friable; many fine and medium roots; about 30 percent fiber unrubbed, 8 percent rubbed; mostly herbaceous fiber; neutral; abrupt smooth boundary.

Oa2—4 to 42 inches; muck, black (10YR 2/1) broken face; moderate medium subangular blocky structure parting to weak fine granular; friable; common very fine and fine roots; about 20 percent fiber unrubbed, less than 5 percent rubbed; mostly herbaceous fiber; neutral; clear smooth boundary.

Cg—42 to 60 inches; dark gray (2.5Y 4/1) coprogenous earth; few medium distinct very dark gray (5Y 3/1) mottles; massive; friable; few very fine roots; about 5 percent snail shells and fragments; violent effervescence; moderately alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches
Content of snail shells and fragments: Up to 15 percent of the volume in the C horizon

Oa horizon:
Hue—10YR, 7.5YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 3
Texture—muck

Cg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 to 5
Chroma—0 to 3
Texture—coprogenous earth, silt loam, or silty clay loam

Hedman Series

Drainage class: Poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy, frigid Typic Calciaquolls

Typical Pedon

Hedman loam, 2,100 feet north and 200 feet west of the southeast corner of sec. 12, T. 146 N., R. 42 W.

A—0 to 12 inches; black (10YR 2/1) loam, very dark gray (10YR3/1) dry; weak fine subangular blocky structure; friable; many fine roots; strong effervescence; 1 percent gravel; slightly alkaline; clear wavy boundary.

Bkg1—12 to 17 inches; dark gray (10YR 4/1) loam; few medium distinct grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; friable; common fine roots; common white (2.5Y 8/2) threads and masses of carbonates; violent effervescence; 2 percent gravel; moderately alkaline; clear wavy boundary.

Bkg2—17 to 21 inches; dark grayish brown (2.5Y 4/2) fine sandy loam; common fine distinct light olive brown (2.5Y 5/4) and light gray (2.5Y 7/2) mottles; weak fine subangular blocky structure; friable; common fine roots; common white (2.5Y 8/2) threads and masses of carbonates; violent effervescence; 2 percent gravel; moderately alkaline; clear wavy boundary.

Cg1—21 to 46 inches; grayish brown (2.5Y 5/2) loam; common medium distinct light gray (2.5Y 7/2) and common fine distinct light olive brown (2.5Y 5/6) mottles; massive; friable; few fine roots; strong effervescence; 5 percent gravel; moderately alkaline; gradual wavy boundary.

Cg2—46 to 60 inches; light brownish gray (2.5Y 6/2) loam; common medium prominent yellowish brown (10YR 5/8) and few faint light gray (2.5Y 7/2) mottles; massive; friable; strong effervescence; 5 percent gravel; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 14 inches
Content of rock fragments: 1 to 10 percent throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

Bkg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam, fine sandy loam, or sandy loam

Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 7
Chroma—1 or 2
Texture—loam, fine sandy loam, or sandy loam

Heimdal Series

Drainage class: Well drained

Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 2 to 20 percent
Taxonomic class: Coarse-loamy, mixed Udic Haploborolls

Typical Pedon

Heimdal loam, 2 to 6 percent slopes, 2,250 feet south and 1,915 feet east of the northwest corner of sec. 12, T. 146 N., R. 41 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; few fine roots; 1 percent gravel; neutral; abrupt smooth boundary.

Bw—8 to 17 inches; brown (10YR 4/3) loam; moderate medium prismatic structure parting to fine medium subangular blocky; friable; few fine roots; common very dark gray (10YR 3/1) wormcasts; 1 percent gravel; neutral; gradual wavy boundary.

Bk—17 to 32 inches; light olive brown (2.5Y 5/4) loam; weak coarse prismatic structure parting to weak medium subangular blocky; friable; common soft white (2.5Y 8/2) threads and masses of carbonates; 3 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

C—32 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 12 to 20 inches
Thickness of the mollic epipedon: 7 to 12 inches
Content of rock fragments: 1 to 10 percent throughout the profile

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—loam

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—loam or fine sandy loam

Bk horizon:
Hue—2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—loam or fine sandy loam

C horizon:
Hue—2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—loam, fine sandy loam, or sandy loam

Karlstad Series

Drainage class: Moderately well drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Landform: Outwash plains and moraines
Parent material: Glacial outwash
Slope range: 1 to 3 percent
Taxonomic class: Coarse-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Karlstad sandy loam, 1,420 feet west and 600 feet north of the southeast corner of sec. 35, T. 146 N., R. 39 W.

A—0 to 2 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; common fine roots; 2 percent gravel; moderately acid; clear wavy boundary.

E—2 to 11 inches; dark grayish brown (10YR 4/2) loamy sand; few fine faint dark yellowish brown (10YR 4/4) mottles; weak fine granular structure; very friable; common fine roots; 2 percent gravel; moderately acid; clear wavy boundary.

Bt1—11 to 20 inches; dark brown (10YR 4/3) sandy loam; few fine faint grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; friable; few fine roots; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and clay bridges between sand grains; 8 percent gravel; neutral; clear wavy boundary.

2Bt2—20 to 25 inches; dark brown (10YR 4/3) gravelly sandy loam; common fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; few fine roots; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and clay bridges between sand grains; 20 percent gravel; slightly alkaline; clear wavy boundary.

2C—25 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; common fine distinct pale brown (10YR 6/3) and very pale brown (10YR 7/3) mottles; single grain; loose; 30 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 12 to 30 inches

A horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—sandy loam
Content of rock fragments—0 to 15 percent

E horizon:
Hue—10YR
Value—4 to 6
Chroma—2 or 3
Texture—loamy sand, sand, or sandy loam
Content of rock fragments—0 to 15 percent

Bt horizon:
Hue—10YR or 7.5YR
Value—3 to 5
Chroma—2 to 4
Texture—sandy loam, fine sandy loam, or sandy clay loam
Content of rock fragments—0 to 15 percent

2Bt horizon:
Hue—10YR or 7.5YR
Value—3 to 5
Chroma—2 to 4
Texture—gravelly sandy loam, gravelly fine sandy loam, or gravelly sandy clay loam
Content of rock fragments—15 to 35 percent

2C horizon:
Hue—10YR or 2.5Y
Value—5 to 7
Chroma—2 to 4
Texture—coarse sand, sand, loamy coarse sand, loamy sand, and the gravelly and very gravelly analogs of these textures
Content of rock fragments—0 to 50 percent

Lamoure Series

Drainage class: Poorly drained
Permeability: Moderately slow or moderate
Landform: Flood plains
Parent material: Alluvial sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls

Typical Pedon

Lamoure silty clay loam, in an area of Fairdale and Lamoure soils, occasionally flooded, 1,300 feet south and 1,700 feet west of the northeast corner of sec. 30, T. 145 N., R. 40 W.

A1—0 to 12 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine granular structure; very friable; many fine and medium roots; slight effervescence; slightly alkaline; clear wavy boundary.

A2—12 to 19 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; weak fine subangular blocky structure parting to weak medium granular; friable; many fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

A3—19 to 26 inches; very dark gray (N 3/0) silty clay loam, gray (N 5/0) dry; weak medium prismatic structure parting to weak very fine subangular blocky; friable; few fine roots; violent effervescence; moderately alkaline; clear wavy boundary.

Cg—26 to 31 inches; gray (5Y 5/1) silty clay loam; few medium distinct light gray (5Y 6/1) mottles; massive; friable; few fine roots; violent effervescence; moderately alkaline; clear smooth boundary.

Ab—31 to 44 inches; very dark gray (5Y 3/1) silt loam; common medium distinct olive gray (5Y 5/2) mottles; weak fine subangular blocky structure; friable; few fine roots; violent effervescence; moderately alkaline; clear smooth boundary.

C′g—44 to 60 inches; olive gray (5Y 5/2) loam; common fine distinct pale olive (5Y 6/4) and few fine distinct light gray (5Y 7/1) mottles; massive; friable; violent effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 24 to 48 inches

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam

Cg or C′g horizon:
Hue—2.5Y, 5Y, or neutral
Value—3 to 5
Chroma—0 to 2
Texture—silty clay loam, silt loam, or loam with thin strata of sandy loam, sand, or gravelly sand

Langhei Series

Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 2 to 20 percent
Taxonomic class: Fine-loamy, mixed (calcareous), frigid Typic Udorthents

Typical Pedon

Langhei loam, in an area of Barnes-Langhei complex, 6 to 12 percent slopes, eroded, 150 feet south and 1,220 feet west of the northeast corner of sec. 10, T. 144 N., R. 41 W.

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; few fine roots; 2 percent gravel; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bk—4 to 32 inches; light olive brown (2.5Y 5/4) loam; massive; friable; 3 percent gravel; common white (2.5Y 8/2) threads of carbonates and carbonate coatings on faces of peds; violent effervescence; moderately alkaline; gradual wavy boundary.

C—32 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; few yellowish brown (10YR 5/8) iron stains in ped interiors; 5 percent gravel; violent effervescence; moderately alkaline.

Range in Characteristics

Content of rock fragments: 2 to 10 percent throughout the profile

Ap horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—1 or 2
Texture—loam

Bk horizon:
Hue—2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—2.5Y
Value—4 to 7
Chroma—2 to 4
Texture—loam or clay loam

Mahkonce Series

Drainage class: Moderately well drained
Permeability: Moderately slow in the upper part, slow in the next part, moderately slow in the lower part
Landform: Moraines
Parent material: Glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine, mixed Aquic Eutroboralfs

Typical Pedon

Mahkonce loam, 2,100 feet south and 1,250 feet west of the northeast corner of sec. 31, T. 146 N., R. 39 W.

A—0 to 4 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; many fine roots; 1 percent gravel; slightly acid; clear wavy boundary.

E—4 to 10 inches; grayish brown (2.5Y 5/2) loam, light brownish gray (2.5Y 6/2) dry; weak fine subangular blocky structure; friable; many fine roots; 1 percent gravel; moderately acid; gradual irregular boundary.

Bt1—10 to 15 inches; dark grayish brown (2.5Y 4/2) clay; few fine faint very dark grayish brown (2.5Y 3/2) mottles; moderate medium subangular blocky structure; firm; common medium roots; continuous faint very dark brown (10YR 2/2) clay films on faces of peds and in pores; 1 percent gravel; slightly acid; gradual wavy boundary.

Bt2—15 to 19 inches; olive brown (2.5Y 4/4) clay; few fine distinct dark grayish brown (2.5Y 4/2) mottles; moderate medium subangular blocky structure; firm; few medium roots; many distinct very dark brown (10YR 2/2) clay films on faces of peds and in pores; 2 percent gravel; neutral; gradual wavy boundary.

Bt3—19 to 26 inches; light olive brown (2.5Y 5/4) clay loam; common fine distinct light brownish gray (2.5Y 6/2) and brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; firm; few medium roots; common prominent very dark brown (10YR 2/2) clay films on faces of peds and in pores; neutral; 2 percent gravel; clear wavy boundary.

C—26 to 60 inches; light olive brown (2.5Y 5/4) clay loam; common medium distinct grayish brown (2.5Y 5/2) and common fine prominent yellowish brown (10YR 5/8) mottles; massive; firm; few medium roots; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Content of rock fragments: 1 to 8 percent throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—loam

E horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 to 3
Texture—loam, silt loam, or fine sandy loam

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—clay, silty clay, silty clay loam, or clay loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—silty clay loam, clay loam, or loam

Markey Series

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the organic material, rapid in the sandy material
Landform: Outwash plains
Parent material: Organic material and glacial outwash
Slope range: 0 to 1 percent
Taxonomic class: Sandy or sandy-skeletal, mixed, euic Terric Borosaprists

Typical Pedon

Markey muck, 2,100 feet south and 1,120 feet west of the northeast corner of sec. 33, T. 146 N., R. 39 W.

Oa1—0 to 13 inches; very dark brown (10YR 2/2) muck, black (10YR 2/1) rubbed; about 15 percent fiber unrubbed, less than 5 percent rubbed; mostly herbaceous fiber; weak thin platy structure; common fine and medium roots; neutral; clear wavy boundary.

Oa2—13 to 19 inches; very dark grayish brown (10YR 3/2) muck, very dark brown (10YR 2/2) rubbed; about 10 percent fiber unrubbed, less than 5 percent rubbed; mostly herbaceous fiber; weak thin platy structure; common fine roots; neutral; clear wavy boundary.

Oa3—19 to 28 inches; very dark brown (10YR 2/2) muck; about 12 percent fiber unrubbed, less than 5 percent rubbed; mostly herbaceous fiber; weak thick platy structure; common fine roots; neutral; clear smooth boundary.

Cg1—28 to 46 inches; grayish brown (2.5Y 5/2) fine sand; single grain; loose; slight effervescence; slightly alkaline; gradual wavy boundary.

Cg2—46 to 60 inches; dark grayish brown (2.5Y 4/2) sand; single grain; loose; slight effervescence; slightly alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches
Depth to carbonates: 16 to 51 inches

Oa horizon:
Hue—10YR, 7.5YR, or neutral
Value—2 to 4
Chroma—0 to 3
Texture—muck

Cg horizon:
Hue—2.5Y, 5Y, or neutral
Value—4 to 6
Chroma—0 to 4
Texture—loamy sand, fine sand, or sand
Content of rock fragments—0 to 15 percent

Marysland Series

Drainage class: Poorly drained
Permeability: Moderate in the upper part, rapid in the lower part
Landform: Outwash channels and low stream terraces
Parent material: Glacial outwash
Slope range: 0 to 1 percent
Taxonomic class: Fine-loamy over sandy or sandy-skeletal, frigid Typic Calciaquolls

Typical Pedon

Marysland loam, occasionally flooded, 1,900 feet east and 400 feet north of the southwest corner of sec. 6, T. 144 N., R. 41 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common fine roots; slight effervescence; moderately alkaline; abrupt smooth boundary.

Ak—8 to 16 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; few fine roots; few soft white (2.5Y 8/2) threads and masses of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

Bkg1—16 to 21 inches; dark gray (10YR 4/1) loam; moderate fine and medium subangular blocky structure; friable; many soft white (2.5Y 8/2) threads and masses of carbonates; violent effervescence; moderately alkaline; gradual wavy boundary.

Bkg2—21 to 33 inches; grayish brown (2.5Y 5/2) loam; common medium distinct yellowish brown (10YR 5/6) and few fine distinct light yellowish brown (2.5Y 6/4) mottles; moderate fine and medium subangular blocky structure; friable; common soft white (2.5Y 8/2) threads and masses of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

2Cg1—33 to 37 inches; light brownish gray (2.5Y 6/2) loamy sand; common medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; 5 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

2Cg2—37 to 60 inches; light brownish gray (2.5Y 6/2) sand; many fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; 10 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 24 inches
Thickness of the upper mantle: 20 to 40 inches

Ap and Ak horizons:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3

Chroma—0 or 1
Texture—loam

Bkg horizon:
Hue—2.5Y, 10YR, 5Y, or neutral
Value—3 to 6
Chroma—0 to 2
Texture—loam, clay loam, sandy clay loam, or fine sandy loam
Content of rock fragments—0 to 10 percent

2Cg horizon:
Hue—2.5Y or 5Y
Value—3 to 6
Chroma—1 or 2
Texture—loamy sand, sand, or coarse sand
Content of rock fragments—5 to 15 percent

Menahga Series

Drainage class: Excessively drained
Permeability: Rapid
Landform: Outwash plains
Parent material: Glacial outwash material
Slope range: 1 to 8 percent
Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Menahga loamy sand, in an area of Graycalm-Menahga complex, 1 to 8 percent slopes, 1,610 feet east and 180 feet south of the northwest corner of sec. 1, T. 143 N., R. 40 W.

A—0 to 3 inches; black (10YR 2/1) loamy sand; weak fine subangular blocky structure; friable; common fine roots; moderately acid; gradual wavy boundary.

AB—3 to 8 inches; dark gray (10YR 4/1) loamy sand; weak fine subangular blocky structure; very friable; common fine roots; moderately acid; clear wavy boundary.

Bw—8 to 22 inches; brown (10YR 5/3) loamy sand; weak very fine subangular blocky structure; very friable; few fine roots; moderately acid; clear wavy boundary.

C1—22 to 50 inches; yellowish brown (10YR 5/4) sand; single grain; loose; slightly acid; clear wavy boundary.

C2—50 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; slightly acid.

Range in Characteristics

Content of rock fragments: 0 to 10 percent throughout the profile
Depth to carbonates: More than 60 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy sand

AB horizon:
Colors—similar to those of the A and Bw horizons
Textures—similar to those of the A and Bw horizons

Bw horizon:
Hue—10YR or 7.5YR
Value—3 to 5
Chroma—3 to 6
Texture—sand, loamy sand, or coarse sand

C horizon:
Hue—7.5YR or 10YR
Value—4 to 6
Chroma—3 to 6
Texture—sand or coarse sand

Naytahwaush Series

Drainage class: Well drained
Permeability: Moderately slow or moderate in the upper part, slow in the next part, moderately slow in the lower part
Landform: Moraines
Parent material: Glacial till
Slope range: 2 to 30 percent
Taxonomic class: Fine, montmorillonitic Mollic Eutroboralfs

Typical Pedon

Naytahwaush loam, 2 to 8 percent slopes, 1,625 feet south and 65 feet east of the northwest corner of sec. 4, T. 144 N., R. 39 W.

A—0 to 4 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; many fine and medium roots; 1 percent gravel; slightly acid; abrupt wavy boundary.

E—4 to 8 inches; very dark gray (10YR 3/1) loam, light brownish gray (10YR 6/1) dry; moderate medium platy structure parting to weak medium subangular blocky; friable; common fine and medium roots; 1 percent gravel; moderately acid; clear wavy boundary.

Bt1—8 to 18 inches; dark brown (10YR 4/3) clay; moderate medium prismatic structure parting to moderate fine angular blocky; very firm; common fine roots; many distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; common black (10YR 2/1) streaks in root channels; 1 percent gravel; slightly acid; clear wavy boundary.

Bt2—18 to 23 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine prismatic structure parting to moderate fine angular blocky; firm; few fine roots; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; common black (10YR 2/1) streaks in root channels; 3 percent gravel; neutral; clear wavy boundary.

BC—23 to 32 inches; yellowish brown (10YR 5/4) silty clay loam; weak fine prismatic structure parting to weak fine angular blocky; firm; few fine roots; few faint dark grayish brown (10YR 4/2) clay films on faces of peds; few very dark grayish brown (10YR 3/2) streaks in root channels; 4 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

C—32 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam; common medium distinct grayish brown (10YR 5/2), relict mottles; massive; firm; few very dark grayish brown (10YR 3/2) streaks in root channels; 4 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches
Content of rock fragments: 1 to 8 percent throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

E horizon:
Hue—10YR or 2.5Y
Value—3 to 6
Chroma—1 to 4
Texture—loam, silt loam, or fine sandy loam

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 6
Chroma—3 or 4
Texture—clay, silty clay, silty clay loam, or clay loam

C horizon:
Hue—2.5Y or 10YR
Value—4 to 6
Chroma—3 to 5
Texture—clay loam or silty clay loam

Nebish Series

Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 2 to 30 percent
Taxonomic class: Fine-loamy, mixed Typic Eutroboralfs

Typical Pedon

Nebish loam, 2 to 8 percent slopes, 450 feet north and 2,400 feet east of the southwest corner of sec. 22, T. 143 N., R. 40 W.

A—0 to 2 inches; very dark gray (10YR 3/1) loam, light gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; many fine and medium roots; 2 percent gravel; slightly acid; abrupt wavy boundary.

E—2 to 5 inches; dark grayish brown (10YR 4/2) loam; moderate thin platy structure parting to moderate fine subangular blocky; friable; common fine and medium roots; 2 percent gravel; slightly acid; clear wavy boundary.

Bt1—5 to 9 inches; dark brown (10YR 4/3) clay loam; moderate medium subangular blocky structure; firm; common medium roots; common light brownish gray (10YR 6/2) sand and silt coatings on faces of peds; very few faint dark grayish brown (10YR 4/2) clay films on faces of peds; 5 percent gravel; moderately acid; gradual wavy boundary.

Bt2—9 to 24 inches; dark brown (10YR 4/3) clay loam; strong medium subangular blocky structure; firm; common medium roots; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; 5 percent gravel; moderately acid; gradual wavy boundary.

C—24 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 36 inches
Content of rock fragments: 2 to 10 percent throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

E horizon:
Hue—10YR
Value—4 to 6
Chroma—2 or 3
Texture—loam, fine sandy loam, or sandy loam

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—clay loam or loam

C horizon:
Hue—2.5Y or 10YR
Value—5 or 6
Chroma—3 or 4

Texture—loam or clay loam

Quam Series

Drainage class: Very poorly drained
Permeability: Moderately slow
Landform: Depressions
Parent material: Water-sorted sediments and glacial till
Slope range: 0 to 1 percent
Taxonomic class: Fine-silty, mixed, frigid Cumulic Haplaquolls

Typical Pedon

Quam silty clay loam, 100 feet south and 1,700 feet west of the northeast corner of sec. 29, T. 143 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few fine and medium roots; neutral; abrupt smooth boundary.

A1—9 to 15 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; few fine roots; neutral; gradual wavy boundary.

A2—15 to 29 inches; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; neutral; gradual wavy boundary.

A3—29 to 44 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; 1 percent gravel; neutral; gradual wavy boundary.

2Cg1—44 to 56 inches; dark grayish brown (2.5Y 4/2) clay loam; few medium distinct olive (5Y 5/4) mottles; friable; few yellowish brown (10YR 5/6) iron stains in ped interiors; 3 percent gravel; neutral; clear wavy boundary.

2Cg2—56 to 60 inches; olive gray (5Y 5/2) clay loam; many large faint olive (5Y 5/3) mottles; massive; friable; many yellowish brown (10YR 5/6) iron stains in ped interiors; 5 percent gravel; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 60 inches
Thickness of the mollic epipedon: 24 to more than 60 inches
Content of rock fragments: 1 to 5 percent in the lower part of the A horizon and throughout the B and C horizons

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, silt loam, silty clay loam, or clay loam

Rockwell Series

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part, rapid in the next part, moderately slow or moderate in the lower part
Landform: Moraines
Parent material: Glacial lacustrine sediments over glacial till
Slope range: 0 to 1 percent
Taxonomic class: Coarse-loamy, frigid Typic Calciaquolls

Typical Pedon

Rockwell loam, 700 feet south and 210 feet east of the northwest corner of sec. 25, T. 146 N., R. 41 W.

Ap—0 to 9 inches; black (2.5Y 2/1) loam, dark gray (2.5Y 4/1) dry; weak fine subangular blocky structure; friable; common fine roots; strong effervescence; slightly alkaline; abrupt smooth boundary.

Bkg1—9 to 17 inches; dark gray (5Y 4/1) loam; weak fine subangular blocky structure; friable; few fine roots; many white (2.5Y 8/2) threads and masses of carbonates; violent effervescence; moderately alkaline; clear wavy boundary.

Bkg2—17 to 27 inches; grayish brown (2.5Y 5/2) fine sandy loam; common fine distinct light olive brown (2.5Y 5/6) and few medium distinct dark gray (5Y 4/1) mottles; weak medium subangular blocky structure; friable; few white (2.5Y 8/2) threads and masses of carbonates; 2 percent gravel; violent effervescence; moderately alkaline; clear wavy boundary.

2Cg1—27 to 34 inches; light brownish gray (2.5Y 6/2) sand; common fine prominent olive yellow (2.5Y 6/6) mottles; single grain; loose; 2 percent gravel; strong effervescence; slightly alkaline; clear smooth boundary.

3Cg2—34 to 60 inches; olive gray (5Y 5/2) loam; few medium prominent light olive brown (2.5Y 5/6) and common medium prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; 3 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches

Thickness of the upper mantle: 20 to 40 inches

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam

Bkg horizon:
Hue—2.5Y, 5Y, or neutral
Value—4 to 6
Chroma—0 to 2
Texture—fine sandy loam or loam
Content of rock fragments—0 to 2 percent

2Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—sand, fine sand, loamy sand, or loamy fine sand
Content of rock fragments—0 to 8 percent

3Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—loam, fine sandy loam, or clay loam
Content of rock fragments—0 to 8 percent

Rothsay Series

Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial lacustrine sediments
Slope range: 1 to 6 percent
Taxonomic class: Coarse-silty, mixed Udic Haploborolls

Typical Pedon

Rothsay silt loam, 1 to 6 percent slopes, 100 feet south and 2,280 feet west of the northeast corner of sec. 31, T. 144 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few fine roots; neutral; abrupt smooth boundary.

A—9 to 13 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR4/1) dry; weak fine subangular blocky structure; friable; few fine roots; neutral; clear wavy boundary.

Bw—13 to 23 inches; brown (10YR 5/3) silt loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; few very fine roots; neutral; clear wavy boundary.

Bk—23 to 35 inches; light yellowish brown (2.5Y 6/4) silt loam; weak medium subangular blocky structure; friable; common soft white (2.5Y 8/2) threads and masses of carbonates; violent effervescence; moderately alkaline; clear wavy boundary.

C—35 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam; massive; friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 12 to 30 inches
Thickness of the mollic epipedon: 7 to 16 inches

Ap and A horizons:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silt loam

Bw horizon:
Hue—10YR
Value—3 to 5
Chroma—2 to 4
Texture—silt loam, loam, or very fine sandy loam

Bk horizon:
Hue—2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—silt loam, loam, or very fine sandy loam

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—silt loam, loam, or very fine sandy loam

Sandberg Series

Drainage class: Excessively drained
Permeability: Rapid or very rapid
Landform: Moraines and outwash plains
Parent material: Outwash
Slope range: 1 to 6 percent
Taxonomic class: Sandy, mixed Udorthentic Haploborolls

Typical Pedon

Sandberg sandy loam, 1 to 6 percent slopes, 2,300 feet west and 1,350 feet north of the southeast corner of sec. 19, T. 146 N., R. 40 W.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; very friable; many fine roots; 6 percent gravel; slightly acid; abrupt smooth boundary.

Bw—10 to 16 inches; dark brown (10YR 3/3) gravelly loamy sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable;

common fine roots; 20 percent gravel; neutral; clear wavy boundary.

C1—16 to 46 inches; light yellowish brown (10YR 6/4) gravelly sand; single grain; loose; 25 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

C2—46 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; 10 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 40 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 5 to 35 percent

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—sandy loam

Bw horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—3 or 4
Texture—sand, coarse sand, loamy coarse sand, loamy sand, or the gravelly analogs of these textures

C horizon:
Hue—10YR or 7.5YR
Value—4 to 6
Chroma—2 to 6
Texture—sand, coarse sand, or the gravelly analogs of these textures

Seelyeville Series

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Landform: Moraines
Parent material: Highly decomposed herbaceous organic material
Slope range: 0 to 10 percent
Taxonomic class: Euic Typic Borosaprists

Typical Pedon

Seelyeville muck, 2,500 feet west and 200 feet south of the northeast corner of sec. 29, T. 143 N., R. 40 W.

Oa1—0 to 44 inches; muck, black (10YR 2/1) broken face, very dark gray (10YR 3/1) rubbed; about 25 percent fiber unrubbed, 5 percent rubbed; mostly herbaceous fiber; many fine roots; moderately acid; clear wavy boundary.

Oa2—44 to 54 inches; muck, dark brown (7.5YR 3/2) broken face, very dark gray (7.5YR 3/0) rubbed; about 75 percent fiber unrubbed, 10 percent rubbed; mostly herbaceous fiber; many fine roots; moderately acid; clear wavy boundary.

Oa3—54 to 60 inches; muck, very dark brown (7.5YR 2/2) broken face and rubbed; about 35 percent fiber unrubbed, 7 percent rubbed; mostly herbaceous fiber; slightly acid.

Range in Characteristics

Thickness of the organic material: More than 51 inches

Oa horizon:
Hue—10YR or 7.5YR
Value—2 or 3
Chroma—1 or 2
Texture—muck

Snellman Series

Drainage class: Well drained
Permeability: Moderate or moderately rapid in the upper part, moderate in the lower part
Landform: Moraines
Parent material: Glacial till
Slope range: 2 to 30 percent
Taxonomic class: Fine-loamy, mixed Typic Eutroboralfs

Typical Pedon

Snellman sandy loam, 8 to 15 percent slopes, 2,510 feet north and 600 feet west of the southeast corner of sec. 10, T. 144 N., R. 39 W.

A—0 to 3 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many fine roots; 3 percent gravel; slightly acid; clear wavy boundary.

E—3 to 15 inches; pale brown (10YR 6/3) loamy sand; weak fine subangular blocky structure; very friable; common medium roots; 3 percent gravel; moderately acid; clear wavy boundary.

Bt1—15 to 19 inches; yellowish brown (10YR 5/4) sandy loam; many pale brown (10YR 6/3) grainy coatings on ped faces; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; weak medium subangular blocky structure; friable; common medium and coarse roots; 5 percent gravel; strongly acid; gradual irregular boundary.

Bt2—19 to 28 inches; yellowish brown (10YR 5/4) sandy clay loam; moderate medium subangular blocky structure; firm; few coarse roots; common prominent very dark grayish brown (10YR 3/2) clay films on faces of peds; 5 percent gravel; moderately acid; gradual wavy boundary.

C—28 to 60 inches; light yellowish brown (2.5Y 6/4) sandy loam; massive; friable; 10 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Content of rock fragments: 2 to 15 percent throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam or fine sandy loam

E horizon:
Hue—10YR
Value—5 or 6
Chroma—3 or 4
Texture—loamy sand, fine sandy loam, or sandy loam

Bt horizon:
Hue—10RY or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—sandy clay loam, loam, or sandy loam

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—3 or 4
Texture—sandy loam, fine sandy loam, or loam

Sugarbush Series

Drainage class: Well drained
Permeability: Moderately rapid or rapid in the upper part, moderately rapid in the next part, very rapid in the lower part
Landform: Valley trains, outwash plains, and moraines
Parent material: Glacial outwash
Slope range: 1 to 30 percent
Taxonomic class: Coarse-loamy, mixed Typic Eutroboralfs

Typical Pedon

Sugarbush sandy loam, in an area of Snellman-Sugarbush complex, 8 to 15 percent slopes, 1,850 feet north and 10 feet west of the southeast corner of sec. 10, T. 143 N., R. 39 W.

A—0 to 2 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; common medium and fine roots; 3 percent gravel; moderately acid; abrupt smooth boundary.

E—2 to 12 inches; yellowish brown (10YR 5/4) loamy sand; weak fine granular structure; very friable; few medium roots; 8 percent gravel; slightly acid; abrupt wavy boundary.

Bt—12 to 25 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; friable; few fine roots; few distinct dark brown (10YR 3/3) clay films on faces of peds; 8 percent gravel; slightly acid; clear wavy boundary.

2C—25 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; 20 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 30 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam or coarse sandy loam
Content of rock fragments—0 to 10 percent

E horizon:
Hue—10YR
Value—4 to 6
Chroma—3 or 4
Texture—loamy sand or loamy coarse sand
Content of rock fragments—0 to 10 percent

Bt horizon:
Hue—10YR or 7.5YR
Value—3 to 5
Chroma—3 to 6
Texture—sandy loam or coarse sandy loam
Content of rock fragments—0 to 10 percent

2C horizon:
Hue—7.5YR or 10YR
Value—5 or 6
Chroma—3 to 6
Texture—sand, gravelly sand, coarse sand, or gravelly coarse sand
Content of rock fragments—10 to 35 percent

Sverdrup Series

Drainage class: Well drained
Permeability: Moderately rapid in the upper part, rapid in the lower part
Landform: Outwash plains and moraines
Parent material: Glacial outwash sediments
Slope range: 1 to 6 percent
Taxonomic class: Sandy, mixed Udic Haploborolls

Typical Pedon

Sverdrup sandy loam, 1 to 6 percent slopes, 75 feet west and 100 feet north of the southeast corner of sec. 3, T. 143 N., R. 42 W.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure;

very friable; few fine roots; 1 percent gravel; neutral; abrupt smooth boundary.

Bw1—10 to 16 inches; very dark grayish brown (10YR 3/2) sandy loam; weak fine granular structure; very friable; few fine roots; 1 percent gravel; neutral; clear wavy boundary.

2Bw2—16 to 27 inches; dark yellowish brown (10YR 4/4) loamy sand; weak fine granular structure; very friable; 1 percent gravel; slightly alkaline; clear wavy boundary.

2C1—27 to 40 inches; light yellowish brown (2.5Y 6/4) fine sand; single grain; loose; 2 percent gravel; slight effervescence; moderately alkaline; clear irregular boundary.

2C2—40 to 60 inches; light yellowish brown (2.5Y 6/4) sand; single grain; loose; 5 percent gravel; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to 36 inches
Thickness of the mollic epipedon: 7 to 16 inches
Thickness of the upper mantle: 14 to 24 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam
Content of rock fragments—0 to 5 percent

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—sandy loam, fine sandy loam, or loam
Content of rock fragments—0 to 5 percent

2Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—loamy fine sand, loamy sand, fine sand, or sand
Content of rock fragments—0 to 5 percent

2C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—sand, fine sand, or loamy sand
Content of rock fragments—1 to 10 percent

Talmoon Series

Drainage class: Poorly drained
Permeability: Moderate in the upper part, moderately slow in the lower part
Landform: Moraines
Parent material: Glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, frigid Mollic Ochraqualfs

Typical Pedon

Talmoon loam, 2,400 feet west and 550 feet south of the northeast corner of sec. 12, T. 143 N., R. 40 W.

A—0 to 5 inches; black (N 2/0) loam, dark gray (N 4/0) dry; weak fine subangular blocky structure; friable; many fine roots; 1 percent gravel; slightly acid; clear wavy boundary.

E—5 to 13 inches; dark gray (5Y 4/1) loam, gray (5Y 5/1) dry; common fine prominent dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; friable; common fine roots; 1 percent gravel; moderately acid; clear wavy boundary.

Btg—13 to 25 inches; olive gray (5Y 4/2) clay loam; many fine prominent dark yellowish brown (10YR 4/6) and common fine prominent strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; firm; common medium roots; common distinct dark gray (2.5Y 4/1) clay films on faces of peds and in pores; 2 percent gravel; slightly acid; gradual wavy boundary.

Cg—25 to 60 inches; olive gray (5Y 5/2) loam; many fine prominent dark yellowish brown (10YR 4/6) and few fine distinct light gray (5Y 6/1) mottles; massive; firm; 5 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches
Content of rock fragments: 1 to 8 percent throughout the profile

A horizon:
Hue—2.5Y, 10YR, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—loam

E horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam, silt loam, or fine sandy loam

Btg horizon:
Hue—5Y or 2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—clay loam, silty clay loam, sandy clay loam

Cg horizon:
Hue—5Y or 2.5Y

Value—5 to 7
Chroma—1 or 2
Texture—loam, sandy clay loam, or clay loam

Two Inlets Series

Drainage class: Somewhat excessively drained
Permeability: Rapid
Landform: Outwash plains, valley trains, and moraines
Parent material: Glacial outwash
Slope range: 1 to 30 percent
Taxonomic class: Sandy, mixed Psammentic Eutroboralfs

Typical Pedon

Two Inlets coarse sandy loam, in an area of Two Inlets-Sugarbush complex, 15 to 30 percent slopes, 1,300 feet north and 350 feet east of the southwest corner of sec. 13, T. 143 N., R. 39 W.

A—0 to 2 inches; very dark gray (10YR 3/1) coarse sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; many fine roots; 2 percent gravel; moderately acid; clear wavy boundary.

E—2 to 11 inches; yellowish brown (10YR 5/4) loamy sand; weak medium granular structure; very friable; common fine roots; 5 percent gravel; moderately acid; gradual wavy boundary.

Bt—11 to 29 inches; dark yellowish brown (10YR 4/4) gravelly loamy sand; weak fine granular structure; very friable; common thin lamellae of dark brown (7.5YR 4/4) sandy loam; 20 percent gravel; slightly acid; clear wavy boundary.

C—29 to 60 inches; brown (10YR5/3) gravelly coarse sand; single grain; loose; 30 percent gravel; slight effervesence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—coarse sandy loam
Content of rock fragments—0 to 35 percent

E horizon:
Hue—10YR
Value—3 to 5
Chroma—3 or 4
Texture—sand, coarse sand, loamy sand, loamy coarse sand, coarse sandy loam, and the gravelly analogs of these textures
Content of rock fragments—0 to 35 percent

Bt horizon:
Hue—7.5YR or 10YR
Value—3 or 4
Chroma—3 or 4
Texture—loamy sand, loamy coarse sand, loamy very coarse sand, and the gravelly analogs of these textures; sandy loam lamellae 1/16 to 1/2 inch thick, total thickness of less than 3 inches
Content of rock fragments—0 to 35 percent

C horizon:
Hue—10YR
Value—4 to 6
Chroma—3 to 6
Texture—gravelly sand, gravelly coarse sand, or gravelly very coarse sand
Content of rock fragments—15 to 35 percent

Urness Series

Drainage class: Very poorly drained
Permeability: Moderate or moderately slow
Landform: Shallow lake basins
Parent material: Glacial lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Fine-silty, mixed (calcareous), frigid Mollic Fluvaquents

Typical Pedon

Urness mucky silt loam, 200 feet north and 1,000 feet east of the southwest corner of sec. 36, T. 145 N., R. 41 W.

A—0 to 12 inches; black (N 2/0) mucky silt loam, dark gray (2.5Y 4/1) dry; weak fine subangular blocky structure; very friable; common fine roots; 1 percent snail-shell fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Cg1—12 to 22 inches; very dark gray (10YR 3/1) mucky silt loam; massive; very friable; common fine and medium roots; few prominent dark brown (7.5YR 3/4) iron stains in root channels and pores; 10 percent snail-shell fragments; violent effervescence; moderately alkaline; gradual wavy boundary.

Cg2—22 to 33 inches; dark gray (N 4/0) mucky silt loam; weak fine granular structure; very friable; few fine roots; few prominent dark brown (7.5YR 3/4) iron stains in root channels and pores; 15 percent snail-shell and clam-shell fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg3—33 to 60 inches; very dark gray (5Y 3/1) mucky silt loam; weak fine granular structure; very friable; few very fine roots; common prominent dark yellowish brown (10YR 4/6) iron stains in root channels and pores; 10 percent snail-shell and clam-shell fragments; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the coprogenous earth: 24 to more than 60 inches
Content of snail-shell fragments: 1 to 15 percent

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 to 4
Chroma—0 to 2
Texture—mucky silt loam

Cg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 to 4
Chroma—0 to 2
Texture—silt loam, silty clay loam, or the mucky analogs of these textures

Vallers Series

Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, frigid Typic Calciaquolls

Typical Pedon

Vallers silty clay loam, 2,500 feet south and 500 feet east of the northwest corner of sec. 27, T. 143 N., R. 42 W.

Ap—0 to 9 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; many fine roots; few very dark gray (10YR 3/1) wormcasts; 1 percent gravel; slight effervescence; moderately alkaline; abrupt smooth boundary.

Bkg1—9 to 19 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct dark grayish brown (10YR 4/2) mottles; weak very fine subangular blocky structure; friable; few fine roots; few black (N 2/0) wormcasts; common white (2.5Y 8/2) threads and masses of carbonates; 2 percent gravel; violent effervescence; moderately alkaline; clear wavy boundary.

Bkg2—19 to 31 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent light olive brown (2.5Y 5/6) and common fine faint light brownish gray (2.5Y 6/2) mottles; weak fine subangular blocky structure; friable; common soft white (2.5Y 8/2) threads and masses of carbonates; 3 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

Cg—31 to 60 inches; grayish brown (2.5Y 5/2) clay loam; many medium prominent light olive brown (2.5Y 5/6) and common medium faint light brownish gray (2.5Y 6/2) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 24 inches
Content of rock fragments: 1 to 8 percent throughout the profile

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam

Bkg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 6
Chroma—1 or 2
Texture—silty clay loam, clay loam, or loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—1 to 3
Texture—loam or clay loam

Waukon Series

Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 2 to 30 percent
Taxonomic class: Fine-loamy, mixed Mollic Eutroboralfs

Typical Pedon

Waukon loam, 2 to 8 percent slopes, 2,200 feet north and 800 feet east of the southwest corner of sec. 34, T. 146 N., R. 40 W.

A—0 to 7 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; common medium roots; 2 percent gravel; neutral; abrupt wavy boundary.

E—7 to 9 inches; dark grayish brown (10YR 4/2) loam, gray (10YR 6/1) dry; moderate fine subangular blocky structure; friable; common fine roots; 2 percent gravel; neutral; clear wavy boundary.

BE—9 to 13 inches; dark brown (10YR 4/3) clay loam; moderate fine subangular blocky structure; firm; many fine roots; common faint grayish brown (10YR 5/2) sand or silt coatings on faces of peds; 3

percent gravel; neutral; clear wavy boundary.

Bt—13 to 24 inches; dark brown (10YR 4/3) clay loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct very dark gray (10YR 3/1) clay films on faces of peds; 5 percent gravel; neutral; clear wavy boundary.

C—24 to 60 inches; light olive brown (2.5Y 5/4) loam; weak fine subangular blocky structure; friable; few fine roots; few prominent strong brown (7.5YR 5/6) iron stains on faces of peds and in pores; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 32 inches
Content of rock fragments: 2 to 8 percent throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam

E horizon:
Hue—10YR
Value—3 or 4
Chroma—1 or 2
Texture—loam, fine sandy loam, or sandy loam

BE horizon:
Colors—similar to those of the Bt and E horizons
Textures—similar to those of the Bt and E horizons

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 to 6
Texture—loam or clay loam

C horizon:
Hue—2.5Y or 10YR
Value—5 or 6
Chroma—3 or 4
Texture—loam or clay loam

Wykeham Series

Drainage class: Moderately well drained
Permeability: Moderate
Landform: Moraines
Parent material: Glacial till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Wykeham fine sandy loam, 1,350 feet north and 120 feet east of the southwest corner of sec. 11, T. 144 N., R. 39 W.

A—0 to 6 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; friable; many fine and medium roots; 1 percent gravel; moderately acid; clear wavy boundary.

E—6 to 10 inches; grayish brown (10YR 5/2) loamy fine sand; weak very fine subangular blocky structure; very friable; common fine roots; 2 percent gravel; moderately acid; clear wavy boundary.

BE—10 to 20 inches; dark brown (10YR 4/3) sandy loam; few fine faint dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; friable; common fine roots; many distinct pale brown (10YR 6/3) sand coatings on faces of peds; 2 percent gravel; moderately acid; clear wavy boundary.

Bt—20 to 30 inches; dark yellowish brown (10YR 4/4) sandy clay loam; common fine distinct dark grayish brown (10YR 4/2) and few fine prominent yellowish brown (10YR 5/8) mottles; moderate fine subangular blocky structure; friable; few fine roots; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; 3 percent gravel; neutral; clear wavy boundary.

BC—30 to 36 inches; yellowish brown (10YR 5/4) sandy loam; common fine distinct dark grayish brown (10YR 4/2) mottles; weak fine subangular blocky structure; friable; few fine roots; few distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; 5 percent gravel; slight effervescence; slightly alkaline; gradual wavy boundary.

C—36 to 60 inches; yellowish brown (10YR 5/4) sandy loam; common fine distinct light brownish gray (10YR 6/2) mottles; massive; friable; few fine roots; 10 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Content of rock fragments: 2 to 15 percent throughout the profile

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—fine sandy loam

E horizon:
Hue—10YR
Value—4 or 5
Chroma—2 to 4
Texture—loamy sand, loamy fine sand, fine sandy loam, or sandy loam

BE horizon:
Colors—similar to those of the Bt and E horizons
Textures—similar to those of the Bt and E horizons

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 to 6
Texture—sandy clay loam, loam, or sandy loam

BC horizon:
Colors—similar to those of the Bt and C horizons
Textures—similar to those of the Bt and C horizons

C horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 to 6
Texture—sandy loam or fine sandy loam

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Formation of the Soils

Soils form through the interaction of various physical, chemical, and biological processes. Five major factors contribute to the formation of soils—the physical and mineralogical composition of the parent material; the climate under which the soil material developed; the plant and animal life in and on the soil; the relief, or lay of the land; and the length of time the forces of soil formation have acted on the soil material (Jenny, 1941). Soil formation becomes evident with the darkening of the surface layer, the development of soil structure, and the differentiation of layers, or horizons.

Parent Material

Most of the soils in Mahnomen County formed in gray or buff-colored, calcareous loamy glacial till from the Des Moines lobe of the Wisconsinan glaciation. The southeastern part of the county has an area of coarser glacial till from the Wadena lobe (Hobbs and Goebel, 1982). Other kinds of parent material in the survey area include glacial outwash and alluvium.

The Erskine Moraine of the Des Moines lobe is a ground moraine. It is in the western half of the county. It is characterized by a gently undulating landscape with small areas of lacustrine sediments, such as silts and sands, over the glacial till. Also included in this moraine are small areas of glacial outwash.

The Big Stone Moraine of the Des Moines lobe is in the eastern half of the county. The glacial till is similar to that of the Erskine Moraine, but the landscape is more rolling and there are areas of clayey till.

The Itasca Moraine of the Wadena lobe is in the southeast corner of the county. The till in this area contains more sand and less clay than that of the Des Moines lobe and has pockets of stratified sands and gravel. A glacial outwash valley train is in the northeast corner of the county and extends southwest through the Twin Lakes area to White Earth Lake. This valley train is about 1 mile wide and consists of sorted sands and gravel.

Recent alluvium is deposited on the flood plains along streams and rivers. The materials deposited range from sand to silty clay loam.

Climate

Climate affects the physical, biological, and chemical properties of the soil. Mahnomen County has a cool, subhumid climate characterized by wide variations in temperature. Except for the effects of frost action, soil formation in this survey area is dormant during the winter.

Differences in the climate in the eastern and western parts of the county result in variations in the kinds of vegetation. The eastern part of the county is wooded because of a higher average precipitation, and the western part is characterized by prairie vegetation. The point at which the prairie vegetation changes to woodland has fluctuated from east to west, depending on the climate at various times in the past (Wright, 1972).

Climate can also affect the chemistry of the soil. A high water table and lower levels of precipitation have resulted in a high content of lime in many of the soils in the western half of the county. Conversely, lime has been leached into the subsoil in areas that support woodland vegetation, where the rate of water infiltration is higher and the water table is lower.

Plants and Animals

The plants and animals that inhabit an area affect the formation of soils. The soils of Mahnomen County support both prairie and woodland vegetation. The type of vegetation changes from prairie grasses in the west to mixed hardwoods in the east.

Some of the prairie grasses that grow in the survey area are big bluestem, little bluestem, indiangrass, and prairie cordgrass. Several species of wildflowers also grow on the prairie. In the marshes, cattails and sedges are common. Soils that formed under prairie vegetation, such as Barnes and Hamlet soils, have a thick, dark surface layer because of the concentration of fibrous roots near the surface and because of the drier climate, which slows the leaching of organic matter. The interaction of the drier climate and the prairie vegetation also results in a less acid surface layer.

Soils that formed in the transitional zone between the prairie vegetation and the woodland vegetation have features of soils that formed under both kinds of plant cover because of the fluctuation of the prairie-forest border in the past (Wright, 1972). Waukon and Gonvick soils are examples.

The dominant tree species in the survey area are oak, aspen, maple, and basswood. Some mixed conifers are near the eastern border of the county. Soils that formed under woodland vegetation, such as Nebish and Beltrami soils, have a thinner, lighter colored surface layer than the prairie soils. Also, the subsoil of the woodland soils has a higher content of clay because of the acidity of the forest vegetation and a more rapid leaching process resulting from the moister environment.

Bacteria, fungi, and other organisms also affect the formation of soils. These organisms aid in the decomposition of organic matter and help to make nutrients available to plants. Animals, such as earthworms, also aid in the breakdown of organic matter. Burrowing animals help to aerate and mix the soil material.

In some areas, human activities have had a significant impact on the formation of the soils. Farming on a slope can cause accelerated erosion, and the eroded soil material accumulates in the lower areas. In cultivated areas, the color of the surface layer can become lighter because of the mixing of the surface layer with the subsoil and the reduction in the content of organic matter. Also, the granular structure of the surface soil may be weakened or destroyed by repeated plowing and compaction by heavy equipment. Human activities can alter the natural drainage pattern and change the type of vegetation that grows in an area.

Relief

Relief influences soil formation through its effect on drainage, vegetation, temperature, and erosion. In areas where the parent material is the same, relief can be the most important factor in determining variations in the kind of soil that forms.

In general, the relief in the western half of the county is nearly level to gently undulating. On this type of landscape, water is not readily removed from the surface. The soils tend to be mottled and have an accumulation of carbonates near the surface because of poor drainage and a high water table. In the deeper depressions, the soils have an organic surface layer and dark colors.

The topography in the eastern half of the county is more rolling than that in the western half. Relief ranges from nearly level to steep. The soils in this part of the county are generally better drained and have brighter colors in the substratum. Soils in gently sloping areas have developed mature profiles with distinct horizons. The soils on the steeper slopes show little profile development because of excessive runoff. Because the rate of water infiltration is slower in these areas, the soils are more droughty and the growth of vegetation is limited.

In areas of hilly topography, the aspect of the slope can affect soil formation. In the forest-prairie transition zone, for example, prairie vegetation grows on the south-facing slopes, where conditions are drier, and woodland vegetation grows on the north-facing slopes.

In some areas where the parent material and the vegetation are similar, relief has been responsible for differences in the type of soil that forms. The well drained Langhei soils are on the steepest part of the slope, the moderately well drained Gonvick soils are in the nearly level areas, the poorly drained Flom soils are in slightly concave depressions, and the very poorly drained Hamre soils are in closed depressions.

Time

In terms of geologic time, the soils in Mahnomen County are young—about 9,000 to 12,000 years old. The soil-forming processes began when the glaciers, which covered the area, receded northward into Canada. Because alluvium from stream and river sediments is deposited each year, the soils have had little time to develop. In general, a long period of time is needed for the other soil-forming factors to take effect.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles 2 millimeters to 38 centimeters (15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches

Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine (end moraine). A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Varve. A sedimentary layer of a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1961-90 at Mahnomen, Minnesota)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	14.7	-6.3	4.2	40	-38	0	0.92	0.37	1.39	3	8.9
February----	21.0	-0.2	10.4	43	-36	0	.61	.35	.83	2	5.6
March-------	35.0	15.2	25.1	62	-25	16	1.17	.56	1.70	3	6.8
April-------	53.5	31.0	42.2	82	6	155	1.67	.54	2.60	4	2.9
May---------	68.3	42.5	55.4	89	22	483	2.67	1.20	3.92	6	.4
June--------	76.0	52.1	64.0	92	35	714	4.01	2.17	5.63	7	.0
July--------	81.4	56.6	69.0	96	40	882	2.79	1.42	3.99	6	.0
August------	79.9	54.3	67.1	96	35	824	3.17	2.12	4.13	6	.0
September---	69.1	44.9	57.0	91	24	506	2.54	1.01	3.83	5	.0
October-----	56.4	34.5	45.5	82	12	220	2.03	.63	3.17	4	1.3
November----	36.1	19.2	27.7	63	-15	22	.88	.37	1.31	2	6.0
December----	20.1	1.6	10.8	45	-32	1	.85	.44	1.20	3	7.7
Yearly:											
Average---	50.9	28.8	39.9	---	---	---	---	---	---	---	---
Extreme---	103	-44	---	98	-39	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,822	23.31	19.44	26.96	51	39.6

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1961-90 at Mahnomen, Minnesota)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 8	May 21	June 1
2 years in 10 later than--	May 2	May 16	May 27
5 years in 10 later than--	Apr. 21	May 7	May 17
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 25	Sept. 16	Aug. 31
2 years in 10 earlier than--	Sept. 30	Sept. 21	Sept. 6
5 years in 10 earlier than--	Oct. 11	Sept. 30	Sept. 17

TABLE 3.--GROWING SEASON

(Recorded in the period 1961-90 at Mahnomen, Minnesota)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	140	125	96
8 years in 10	148	131	105
5 years in 10	163	142	122
2 years in 10	178	153	139
1 year in 10	186	159	148

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
33B	Barnes loam, 2 to 6 percent slopes	12,345	3.3
36	Flom silty clay loam	8,430	2.3
38B	Waukon loam, 2 to 8 percent slopes	3,170	0.9
38C	Waukon loam, 8 to 15 percent slopes	4,045	1.1
38E	Waukon loam, 15 to 30 percent slopes	720	0.2
40B	Nebish loam, 2 to 8 percent slopes	4,570	1.2
40C	Nebish loam, 8 to 15 percent slopes	2,170	0.6
40E	Nebish loam, 15 to 30 percent slopes	470	0.1
59	Grimstad sandy loam	1,965	0.5
63	Rockwell loam	2,290	0.6
121	Wykeham fine sandy loam	710	0.2
125	Beltrami loam	820	0.2
127B	Sverdrup sandy loam, 1 to 6 percent slopes	1,690	0.5
180	Gonvick loam	1,805	0.5
191	Epoufette sandy loam	2,650	0.7
205	Karlstad sandy loam	1,930	0.5
236	Vallers silty clay loam	22,435	5.9
267B	Snellman sandy loam, 2 to 8 percent slopes	6,330	1.7
267C	Snellman sandy loam, 8 to 15 percent slopes	3,750	1.0
267E	Snellman sandy loam, 15 to 30 percent slopes	1,510	0.4
290B	Rothsay silt loam, 1 to 6 percent slopes	1,150	0.3
296	Fram loam	2,100	0.6
332B	Sugarbush sandy loam, 1 to 8 percent slopes	6,155	1.6
335	Urness mucky silt loam	430	0.1
344	Quam silty clay loam	865	0.2
346	Talmoon loam	720	0.2
352B	Heimdal loam, 2 to 6 percent slopes	3,610	1.0
426	Foldahl sandy loam	1,425	0.4
494B	Darnen loam, 2 to 6 percent slopes	670	0.2
540	Seelyeville muck	3,930	1.1
543	Markey muck	2,650	0.7
544	Cathro muck	3,270	0.9
718B	Naytahwaush loam, 2 to 8 percent slopes	19,320	5.1
718C	Naytahwaush loam, 8 to 15 percent slopes	13,630	3.6
718E	Naytahwaush loam, 15 to 30 percent slopes	3,655	1.0
737	Mahkonce loam	4,680	1.3
746	Haslie muck	370	0.1
748	Hamlet loam	1,860	0.5
749	Colvin silt loam, occasionally flooded	585	0.2
767	Auganaush loam	6,155	1.6
775B	Sugarbush-Two Inlets complex, 1 to 8 percent slopes	290	0.1
775C	Sugarbush-Two Inlets complex, 8 to 15 percent slopes	2,315	0.6
776B	Snellman-Sugarbush complex, 2 to 8 percent slopes	2,550	0.7
776C	Snellman-Sugarbush complex, 8 to 15 percent slopes	3,640	1.0
776E	Snellman-Sugarbush complex, 15 to 30 percent slopes	1,785	0.5
827B	Heimdal-Esmond complex, 2 to 6 percent slopes	2,875	0.8
827C2	Heimdal-Esmond complex, 6 to 12 percent slopes, eroded	850	0.2
867B	Graycalm-Menahga complex, 1 to 8 percent slopes	1,710	0.5
903B	Barnes-Langhei complex, 2 to 6 percent slopes	19,840	5.2
903C2	Barnes-Langhei complex, 6 to 12 percent slopes, eroded	6,350	1.7
942D2	Langhei-Barnes complex, 12 to 20 percent slopes, eroded	845	0.2
967B	Waukon-Langhei complex, 2 to 6 percent slopes	11,880	3.2
967C2	Waukon-Langhei complex, 6 to 12 percent slopes, eroded	12,520	3.4
979D2	Langhei-Waukon complex, 12 to 20 percent slopes, eroded	2,055	0.6
1030	Pits, gravel-Udipsamments complex	320	0.1
1113	Haslie, Seelyeville, and Cathro soils, ponded	19,410	5.1
1117	Hedman loam	8,400	2.3
1139	Marysland loam, occasionally flooded	1,760	0.5
1142	Hedman-Fram complex	11,535	3.1
1147	Fordum, Fairdale, and Lamoure soils, frequently flooded	6,335	1.7
1148	Fairdale and Lamoure soils, occasionally flooded	890	0.2
1149	Hamerly clay loam	10,850	2.9
1152B	Sugarbush loamy sand, 1 to 8 percent slopes	6,160	1.7

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
1152C	Sugarbush loamy sand, 8 to 15 percent slopes	440	0.1
1152E	Sugarbush loamy sand, 15 to 30 percent slopes	180	0.1
1200	Egglake loam	480	0.1
1233D2	Esmond-Heimdal complex, 12 to 20 percent slopes, eroded	200	0.1
1238E	Two Inlets-Sugarbush complex, 15 to 30 percent slopes	1,205	0.3
1241B	Sandberg sandy loam, 1 to 6 percent slopes	795	0.2
1804	Hamre muck, ponded	7,070	1.9
1825B	Seelyeville muck, sloping, seep land	355	0.1
1878	Hamre muck	4,325	1.2
1967	Hamerly-Vallers complex	46,550	12.3
	Water	15,500	4.2
	Total	373,300	100.0

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
33B	Barnes loam, 2 to 6 percent slopes
36	Flom silty clay loam (where drained)
38B	Waukon loam, 2 to 8 percent slopes
40B	Nebish loam, 2 to 8 percent slopes
59	Grimstad sandy loam
63	Rockwell loam (where drained)
121	Wykeham fine sandy loam
125	Beltrami loam
180	Gonvick loam
236	Vallers silty clay loam (where drained)
267B	Snellman sandy loam, 2 to 8 percent slopes
290B	Rothsay silt loam, 1 to 6 percent slopes
296	Fram loam
346	Talmoon loam (where drained)
352B	Heimdal loam, 2 to 6 percent slopes
426	Foldahl sandy loam
494B	Darnen loam, 2 to 6 percent slopes
718B	Naytahwaush loam, 2 to 8 percent slopes
737	Mahkonce loam
748	Hamlet loam
749	Colvin silt loam, occasionally flooded (where drained)
767	Auganaush loam (where drained)
827B	Heimdal-Esmond complex, 2 to 6 percent slopes
903B	Barnes-Langhei complex, 2 to 6 percent slopes
967B	Waukon-Langhei complex, 2 to 6 percent slopes
1117	Hedman loam (where drained)
1142	Hedman-Fram complex (where drained)
1149	Hamerly clay loam
1200	Egglake loam (where drained)
1967	Hamerly-Vallers complex (where drained)

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Spring wheat	Barley	Soybeans	Corn silage	Alfalfa-hay	Bromegrass-alfalfa	Reed canarygrass
		Bu	Bu	Bu	Tons	Tons	AUM*	AUM*
33B------------- Barnes	2e	50	70	34	16	4.2	5.6	---
36-------------- Flom	2w	40	60	30	15	4.3	5.5	---
38B------------- Waukon	2e	45	65	28	14	3.8	4.9	---
38C------------- Waukon	3e	30	50	22	13	3.5	4.6	---
38E------------- Waukon	6e	---	---	---	---	---	3.0	---
40B------------- Nebish	2e	35	55	24	14	3.4	4.6	---
40C------------- Nebish	3e	25	45	17	12	3.2	4.4	---
40E------------- Nebish	6e	---	---	---	---	---	3.0	---
59-------------- Grimstad	2s	40	60	26	15	3.5	5.3	---
63-------------- Rockwell	2w	35	55	24	14	3.6	5.2	---
121------------- Wykeham	1	40	60	30	16	4.0	5.4	---
125------------- Beltrami	1	45	65	32	17	4.2	5.6	---
127B------------ Sverdrup	3e	30	45	18	11	2.7	3.8	---
180------------- Gonvick	1	50	70	34	16	4.3	6.0	---
191------------- Epoufette	4w	15	30	10	3	1.6	2.6	6.0
205------------- Karlstad	4s	30	50	20	11	2.8	4.0	---
236------------- Vallers	2w	40	60	22	15	4.0	5.5	---
267B------------ Snellman	2e	30	50	22	10	2.4	5.2	---
267C------------ Snellman	3e	25	45	18	8	2.2	4.9	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Spring wheat	Barley	Soybeans	Corn silage	Alfalfa-hay	Bromegrass-alfalfa	Reed canarygrass
		Bu	Bu	Bu	Tons	Tons	AUM*	AUM*
267E------------ Snellman	6e	---	---	---	---	---	3.0	---
290B------------ Rothsay	2e	55	75	30	16	4.3	5.8	---
296------------- Fram	2e	45	65	26	14	3.8	5.2	---
332B------------ Sugarbush	3s	20	40	15	6	2.0	3.0	---
335------------- Urness	3w	25	45	14	7	2.5	3.5	4.5
344------------- Quam	3w	35	55	26	12	3.2	4.4	4.5
346------------- Talmoon	2w	35	55	26	12	3.4	5.0	---
352B------------ Heimdal	2e	50	70	34	16	4.2	5.6	---
426------------- Foldahl	2s	35	55	24	12	3.4	5.0	---
494B------------ Darnen	2e	55	75	30	16	4.3	6.0	---
540------------- Seelyeville	6w	---	---	---	---	---	---	3.5
543------------- Markey	6w	---	---	---	---	---	---	3.5
544------------- Cathro	4w	30	50	20	10	2.5	3.5	6.0
718B------------ Naytahwaush	2e	40	60	24	12	3.4	4.6	---
718C------------ Naytahwaush	3e	30	50	20	10	3.0	4.2	---
718E------------ Naytahwaush	6e	---	---	---	---	---	3.0	---
737------------- Mahkonce	2s	45	65	28	15	4.2	5.6	---
746------------- Haslie	6w	---	---	---	---	---	---	3.0
748------------- Hamlet	1	60	80	42	18	4.5	6.2	---
749------------- Colvin	3w	40	60	25	14	3.8	4.8	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Spring wheat	Barley	Soybeans	Corn silage	Alfalfa-hay	Bromegrass-alfalfa	Reed canarygrass
		Bu	Bu	Bu	Tons	Tons	AUM*	AUM*
767 Auganaush	4w	20	40	22	10	2.5	3.8	---
775B		15	30	10	4	2.0	2.8	---
Sugarbush	3s							
Two Inlets	4s							
775C		10	20	6	2	1.6	2.4	---
Sugarbush	4e							
Two Inlets	4s							
776B		20	40	13	5	2.2	3.2	---
Snellman	2e							
Sugarbush	3s							
776C		15	25	10	3	1.8	2.8	---
Snellman	3e							
Sugarbush	4e							
776E Snellman-Sugarbush	6e	---	---	---	---	---	2.4	---
827B		45	65	28	15	4.0	5.3	---
Heimdal	2e							
Esmond	3e							
827C2		30	50	20	11	2.8	4.2	---
Heimdal	3e							
Esmond	6e							
867B Graycalm-Menahga	4s	20	40	12	5	2.0	3.0	---
903B		45	65	30	16	4.2	5.4	---
Barnes	2e							
Langhei	3e							
903C2		35	55	24	13	3.4	4.6	---
Barnes	3e							
Langhei	4e							
942D2		25	45	18	9	2.4	3.6	---
Langhei	6e							
Barnes	4e							
967B		40	60	27	15	4.0	5.0	---
Waukon	2e							
Langhei	3e							
967C2		30	50	22	11	2.6	3.8	---
Waukon	3e							
Langhei	4e							
979D2		20	40	15	8	2.0	3.0	---
Langhei	6e							
Waukon	4e							

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Spring wheat	Barley	Soybeans	Corn silage	Alfalfa-hay	Bromegrass-alfalfa	Reed canarygrass
		Bu	Bu	Bu	Tons	Tons	AUM*	AUM*
1030. Pits- Udipsamments								
1113 Haslie, Seelyeville, and Cathro	8w	---	---	---	---	---	---	---
1117 Hedman	2w	40	60	25	15	4.0	6.0	---
1139 Marysland	3w	35	55	22	11	3.2	4.4	---
1142		45	65	27	15	4.0	5.6	---
Hedman	2w							
Fram	2e							
1147 Fordum, Fairdale, and Lamoure	6w	---	---	---	---	---	---	3.0
1148		35	55	24	13	3.4	4.9	---
Fairdale	2w							
Lamoure	4w							
1149 Hamerly	2s	50	70	30	16	4.2	5.6	---
1152B Sugarbush	3s	15	35	12	5	1.8	2.8	---
1152C Sugarbush	4e	10	30	10	3	1.6	2.4	---
1152E Sugarbush	6e	---	---	---	---	---	2.0	---
1200 Egglake	2w	30	50	20	10	2.8	4.0	---
1233D2		20	40	15	8	2.0	3.0	---
Esmond	7e							
Heimdal	4e							
1238E		---	---	---	---	---	2.0	---
Two Inlets	6s							
Sugarbush	6e							
1241B Sandberg	4s	15	25	12	4	1.8	3.3	---
1804 Hamre	8w	---	---	---	---	---	---	---
1825B Seelyeville	6w	---	---	---	---	---	---	2.0

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Spring wheat	Barley	Soybeans	Corn silage	Alfalfa-hay	Bromegrass-alfalfa	Reed canarygrass
		Bu	Bu	Bu	Tons	Tons	AUM*	AUM*
1878------------ Hamre	3w	35	55	22	10	3.0	4.0	6.0
1967------------		45	65	28	16	4.2	5.6	---
Hamerly--------	2s							
Vallers--------	2w							

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available. See text for definitions of "slight," "moderate," and "severe")

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
38B, 38C Waukon	2L	Slight	Moderate	Slight	Slight	Severe	Bur oak	50	2	Eastern white pine, white spruce, northern red oak.
							Sugar maple	58	3	
							Quaking aspen	72	6	
							Green ash	62	4	
							American basswood	80	6	
38E Waukon	2R	Moderate	Moderate	Slight	Slight	Severe	Bur oak	50	2	Eastern white pine, white spruce, northern red oak.
							Sugar maple	58	3	
							Quaking aspen	72	6	
							Green ash	62	4	
							American basswood	80	6	
40B, 40C Nebish	6L	Slight	Moderate	Slight	Slight	Severe	Quaking aspen	76	6	White spruce, eastern white pine, northern red oak, balsam fir.
							Paper birch	67	5	
							American basswood	75	5	
							Sugar maple	59	3	
							Northern red oak	65	4	
							Balsam fir	65	9	
							White spruce	60	8	
							Eastern white pine	55	7	
							Red pine	55	6	
40E Nebish	6R	Moderate	Moderate	Slight	Slight	Severe	Quaking aspen	76	6	White spruce, eastern white pine, northern red oak, balsam fir.
							Paper birch	67	5	
							American basswood	75	5	
							Sugar maple	59	3	
							Northern red oak	65	4	
							Balsam fir	65	9	
							White spruce	60	8	
							Eastern white pine	55	7	
							Red pine	55	6	
121 Wykeham	6L	Slight	Moderate	Slight	Slight	Moderate	Quaking aspen	70	6	Eastern white pine, red pine, northern red oak, white spruce.
							Sugar maple	60	3	
							American basswood	70	5	
							White spruce	60	8	
							Red pine	60	7	
							Eastern white pine	60	8	
							Northern red oak	65	4	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
125-----------------	7L	Slight	Severe	Slight	Slight	Severe	Eastern white pine--	55	7	White spruce, eastern white pine, northern red oak.
Beltrami							Quaking aspen-------	77	6	
							White spruce--------	60	8	
							American basswood---	70	5	
							Northern red oak----	65	4	
							Sugar maple---------	60	3	
180-----------------	2A	Slight	Slight	Slight	Slight	Severe	Bur oak-------------	50	2	White spruce, eastern white pine, northern red oak.
Gonvick							Quaking aspen-------	85	7	
							American basswood---	81	6	
							Sugar maple---------	57	2	
							Green ash-----------	72	5	
191-----------------	2W	Slight	Severe	Moderate	Severe	Severe	Quaking aspen-------	45	2	Black spruce, balsam fir.
Epoufette							Black ash-----------	35	2	
							Balsam fir----------	35	4	
							Black spruce--------	40	4	
205-----------------	5L	Slight	Moderate	Slight	Slight	Moderate	Quaking aspen-------	65	5	Red pine, white spruce.
Karlstad							Red pine------------	55	6	
							Eastern white pine--	55	7	
							Jack pine-----------	60	6	
							Bur oak-------------	36	2	
267B, 267C----------	6L	Slight	Moderate	Slight	Slight	Moderate	Quaking aspen-------	70	6	Red pine, northern red oak, eastern white pine.
Snellman							Paper birch---------	60	4	
							Northern red oak----	60	4	
							Sugar maple---------	55	2	
							Bur oak-------------	50	2	
							Red pine------------	50	5	
							Eastern white pine--	50	6	
							American basswood---	70	5	
							White spruce--------	60	8	
267E----------------	6R	Moderate	Moderate	Slight	Slight	Moderate	Quaking aspen-------	70	6	Red pine, northern red oak, eastern white pine.
Snellman							Paper birch---------	60	4	
							Northern red oak----	60	4	
							Sugar maple---------	55	2	
							Bur oak-------------	50	2	
							Red pine------------	50	5	
							Eastern white pine--	50	6	
							American basswood---	70	5	
							White spruce--------	60	8	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
332B---------------- Sugarbush	6A	Slight	Slight	Slight	Slight	Moderate	Quaking aspen-------	60	4	Red pine, jack pine, eastern white pine.
							Sugar maple---------	45	2	
							Bur oak-------------	45	2	
							Red pine------------	55	6	
							Jack pine-----------	55	6	
							Eastern white pine--	50	6	
							Paper birch---------	55	4	
346----------------- Talmoon	6W	Slight	Severe	Slight	Moderate	Severe	Quaking aspen-------	72	6	White spruce, black spruce, eastern white pine, balsam fir.
							Paper birch---------	65	5	
							Balsam fir----------	60	8	
							American basswood---	65	4	
							Black ash-----------	65	3	
							White spruce--------	60	8	
540----------------- Seelyeville	3W	Slight	Severe	Severe	Severe	Severe	Black spruce--------	34	3	Black spruce, tamarack, northern whitecedar, balsam fir.
							Tamarack------------	56	4	
							Black ash-----------	55	2	
							Northern whitecedar-	30	3	
							Balsam fir----------	45	6	
718B, 718C---------- Naytahwaush	6D	Slight	Severe	Severe	Slight	Severe	Quaking aspen-------	77	6	Eastern white pine, white spruce, northern red oak.
							Eastern white pine--	49	6	
							American basswood---	50	2	
							Sugar maple---------	60	2	
							White spruce--------	52	7	
718E---------------- Naytahwaush	6R	Moderate	Severe	Severe	Slight	Severe	Quaking aspen-------	77	6	Eastern white pine, white spruce, northern red oak.
							Eastern white pine--	49	6	
							American basswood---	50	2	
							Sugar maple---------	60	2	
							White spruce--------	52	7	
737----------------- Mahkonce	2C	Slight	Severe	Slight	Slight	Severe	Bur oak-------------	50	2	White spruce, eastern white pine, northern red oak.
							Quaking aspen-------	80	7	
							American basswood---	65	4	
							White spruce--------	60	8	
							Sugar maple---------	62	3	
746----------------- Haslie	2W	Slight	Severe	Severe	Severe	Severe	Tamarack------------	50	3	Tamarack, black spruce.
							Black spruce--------	41	2	
							White ash-----------	52	2	
							Black ash-----------	55	2	
							Paper birch---------	30	3	
							Quaking aspen-------	56	4	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordi-nation symbol	Management concerns					Potential productivity			Trees to plant
		Erosion hazard	Equip-ment limita-tion	Seedling mortal-ity	Wind-throw hazard	Plant competi-tion	Common trees	Site index	Produc-tivity class*	
767---------------- Auganaush	6W	Slight	Severe	Moderate	Moderate	Severe	Quaking aspen-------	75	6	Balsam fir, white spruce, northern whitecedar.
							Balsam fir----------	60	8	
							Black ash-----------	65	3	
							White spruce--------	60	8	
							American basswood---	65	4	
775B, 775C:										
Sugarbush---------	6A	Slight	Slight	Slight	Slight	Moderate	Quaking aspen-------	60	4	Red pine, jack pine, eastern white pine.
							Sugar maple---------	45	2	
							Bur oak-------------	45	2	
							Red pine------------	55	6	
							Jack pine-----------	55	6	
							Eastern white pine--	50	6	
							Paper birch---------	55	4	
Two Inlets--------	6S	Slight	Slight	Moderate	Slight	Slight	Quaking aspen-------	60	4	Red pine, jack pine.
							Bur oak-------------	45	2	
							Red pine------------	55	6	
							Jack pine-----------	55	6	
							Paper birch---------	55	4	
776B, 776C:										
Snellman----------	6L	Slight	Moderate	Slight	Slight	Moderate	Quaking aspen-------	70	6	Red pine, northern red oak, eastern white pine.
							Paper birch---------	60	4	
							Northern red oak----	60	4	
							Sugar maple---------	55	2	
							Bur oak-------------	50	2	
							Red pine------------	50	5	
							Eastern white pine--	50	6	
							American basswood---	70	5	
							White spruce--------	60	8	
Sugarbush---------	6A	Slight	Slight	Slight	Slight	Moderate	Quaking aspen-------	60	4	Red pine, jack pine, eastern white pine.
							Sugar maple---------	45	2	
							Bur oak-------------	45	2	
							Red pine------------	55	6	
							Jack pine-----------	55	6	
							Eastern white pine--	50	6	
							Paper birch---------	55	4	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
776E:										
Snellman	6R	Moderate	Moderate	Slight	Slight	Moderate	Quaking aspen	70	6	Red pine, northern red oak, eastern white pine.
							Paper birch	60	4	
							Northern red oak	60	4	
							Sugar maple	55	2	
							Bur oak	50	2	
							Red pine	50	5	
							Eastern white pine	50	6	
							American basswood	70	5	
							White spruce	60	8	
Sugarbush	6R	Moderate	Moderate	Slight	Slight	Moderate	Quaking aspen	60	4	Red pine, jack pine, eastern white pine.
							Sugar maple	45	2	
							Bur oak	45	2	
							Red pine	55	6	
							Jack pine	55	6	
							Eastern white pine	50	6	
							Paper birch	55	4	
867B:										
Graycalm	7A	Slight	Slight	Slight	Slight	Moderate	Red pine	61	7	Red pine, eastern white pine, white spruce, jack pine, balsam fir.
							Jack pine	67	7	
							Quaking aspen	65	5	
							Eastern white pine	55	7	
							White spruce	60	8	
							Paper birch	60	4	
							Northern red oak	55	3	
							Balsam fir	58	8	
Menahga	6S	Slight	Moderate	Moderate	Slight	Slight	Jack pine	59	6	Red pine, white spruce, eastern white pine, jack pine.
							Red pine	60	7	
							Eastern white pine	55	7	
							Quaking aspen	65	5	
							Paper birch	60	4	
1152B, 1152C: Sugarbush	6A	Slight	Slight	Slight	Slight	Moderate	Quaking aspen	60	4	Red pine, jack pine, eastern white pine.
							Sugar maple	45	2	
							Bur oak	45	2	
							Red pine	55	6	
							Jack pine	55	6	
							Eastern white pine	50	6	
							Paper birch	55	4	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
1152E Sugarbush	6R	Moderate	Moderate	Slight	Slight	Moderate	Quaking aspen	60	4	Red pine, jack pine, eastern white pine.
							Sugar maple	45	2	
							Bur oak	45	2	
							Red pine	55	6	
							Jack pine	55	6	
							Eastern white pine	50	6	
							Paper birch	55	4	
1200 Egglake	6W	Slight	Severe	Slight	Moderate	Severe	Quaking aspen	72	6	White spruce, black spruce, eastern white pine, balsam fir.
							Bigtooth aspen	72	6	
							Balsam fir	60	10	
							American basswood	65	4	
							Black ash	65	3	
							White spruce	56	1	
1238E: Two Inlets	6R	Moderate	Moderate	Moderate	Slight	Slight	Quaking aspen	60	4	Red pine, jack pine.
							Bur oak	45	2	
							Red pine	55	6	
							Jack pine	55	6	
							Paper birch	55	4	
Sugarbush	6R	Moderate	Moderate	Slight	Slight	Moderate	Quaking aspen	60	4	Red pine, jack pine, eastern white pine.
							Sugar maple	45	2	
							Bur oak	45	2	
							Red pine	55	6	
							Jack pine	55	6	
							Eastern white pine	50	6	
							Paper birch	55	4	

* Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(Only the soils suitable for windbreaks and environmental plantings are listed. The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
33B Barnes	Buffaloberry	Eastern redcedar, Siberian peashrub, American plum, lilac.	Blue spruce, ponderosa pine, red splendor crabapple, northern whitecedar.	Green ash, honeylocust.	Siberian elm, Siouxland cottonwood, hybrid poplar.
36 Flom	---	Silky dogwood, common chokecherry, Amur maple, arrowwood, redosier dogwood.	White spruce, Black Hills spruce, Norway spruce, hackberry, basswood, northern whitecedar.	Siberian elm, golden willow, green ash, northern red oak.	Siouxland cottonwood, silver maple, Norway poplar.
38B, 38C, 38E Waukon	---	American cranberrybush, hedge cotoneaster, arrowwood, Siberian peashrub, late lilac, Amur maple.	Nannyberry viburnum, red splendor crabapple, northern whitecedar, blue spruce, white spruce.	Silver maple, Norway spruce, green ash, red pine.	Siouxland cottonwood, Norway poplar.
40B, 40C, 40E Nebish	---	Amur maple, redosier dogwood, Siberian peashrub, lilac.	Hackberry, northern whitecedar, white spruce, eastern redcedar, red splendor crabapple, blue spruce.	Eastern white pine, green ash, red pine.	---
59 Grimstad	Lilac	Eastern redcedar, common chokecherry, Siberian peashrub, late lilac.	Black Hills spruce, white spruce, bur oak, Scotch pine, viburnum.	Golden willow, Siberian elm, hackberry, green ash.	Siouxland cottonwood.
63 Rockwell	---	Buffaloberry, common chokecherry, silky dogwood, redosier dogwood, caragana.	Black Hills spruce, white spruce, hackberry, northern whitecedar.	Siberian elm, golden willow, green ash.	Siouxland cottonwood.
121 Wykeham	---	Lilac, redosier dogwood, blue spruce, Siberian peashrub, American cranberrybush, late lilac.	White spruce, northern whitecedar, Scotch pine, viburnum, hackberry.	Norway spruce, eastern white pine, jack pine, red pine, green ash.	Siouxland cottonwood.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
125. Beltrami	---	Redosier dogwood, lilac, American cranberrybush, Siberian peashrub, late lilac, cotoneaster.	White spruce, eastern redcedar, Scotch pine, viburnum, hackberry.	Norway spruce, eastern white pine, green ash, red pine.	---
127B. Sverdrup	Lilac, Peking cotoneaster, buffaloberry, late lilac.	Siberian peashrub, eastern redcedar, Manchurian crabapple, hackberry.	White spruce, red pine, Siberian elm, jack pine.	Green ash.	---
180. Gonvick	---	Siberian peashrub, American cranberrybush, lilac, redosier dogwood.	Eastern redcedar, white spruce, blue spruce, hackberry.	Norway spruce, red pine, eastern white pine, green ash.	---
191. Epoufette	---	Redosier dogwood, American plum, lilac.	Blue spruce, northern whitecedar, white spruce.	Golden willow, green ash.	Siouxland cottonwood.
205. Karlstad	---	Northern whitecedar, Siberian peashrub, lilac.	Bur oak, blue spruce, white spruce, eastern redcedar.	Golden willow, green ash.	Siouxland cottonwood.
236. Vallers	---	Lilac, Siberian peashrub, common chokecherry, eastern redcedar.	White spruce, bur oak, blue spruce.	Golden willow, Siberian elm, green ash.	---
267B, 267C, 267E. Snellman	Peking cotoneaster	American cranberrybush, American plum, lilac, Amur maple, common chokecherry, Siberian peashrub, arrowwood, silver buffaloberry.	Eastern redcedar, hackberry, blue spruce, Siberian crabapple, white spruce, red splendor crabapple.	Eastern white pine, green ash, Siberian elm, red pine, silver maple.	Hybrid poplar, Siouxland cottonwood.
290B. Rothsay	---	Eastern redcedar, redosier dogwood, Siberian peashrub, American plum, lilac.	Red splendor crabapple, blue spruce, green ash, ponderosa pine, Russian-olive, bur oak.	---	Siouxland cottonwood, hybrid poplar.
296. Fram	---	Siberian peashrub, blue spruce, eastern redcedar, lilac, American plum.	Ponderosa pine, hackberry, red splendor crabapple.	Golden willow, green ash.	Siouxland cottonwood.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
332B-------------- Sugarbush	Late lilac--------	American plum, Amur maple, bur oak, common chokecherry, eastern redcedar, Manchurian crabapple, sargent crabapple, silver buffaloberry.	Blue spruce, jack pine, red pine, Siberian elm, white spruce.	Green ash---------	Siouxland cottonwood.
335--------------- Urness	Redosier dogwood	---	---	White willow, golden willow.	---
344--------------- Quam	---	Black spruce, redosier dogwood.	Tamarack, black ash, tall purple willow.	Golden willow, black willow, white willow.	---
346--------------- Talmoon	---	Eastern redcedar, redosier dogwood.	Northern whitecedar, white spruce.	Golden willow, eastern white pine, Norway spruce, green ash.	---
352B-------------- Heimdal	Nanking cherry----	American plum, Siberian peashrub, lilac, silver buffaloberry.	Black Hills spruce, blue spruce, hackberry.	Green ash, silver maple.	Siouxland cottonwood.
426--------------- Foldahl	---	Eastern redcedar, American plum, common chokecherry, Peking cotoneaster, Siberian peashrub.	Blue spruce, red splendor crabapple, white spruce, hackberry.	Golden willow-----	Siouxland cottonwood.
494B-------------- Darnen	---	American plum, redosier dogwood, eastern redcedar, lilac, Siberian peashrub.	Hackberry, blue spruce, bur oak, ponderosa pine, red splendor crabapple.	Siberian elm, green ash.	---
540--------------- Seelyeville	Common ninebark---	---	---	Golden willow, white willow.	Hybrid poplar.
544--------------- Cathro	Common ninebark---	Redosier dogwood, black spruce.	Black ash, tamarack.	Golden willow, white willow.	Hybrid poplar.
718B, 718C, 718E-- Naytahwaush	---	Amur maple, Siberian peashrub, lilac, American plum.	Blue spruce, white spruce, sugar maple.	Green ash, silver maple, eastern white pine.	---
737--------------- Mahkonce	---	Siberian peashrub, Amur maple, common chokecherry, lilac.	White spruce------	Red pine, green ash, eastern white pine.	Siouxland cottonwood.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
746 Haslie	Redosier dogwood	---	---	White willow, golden willow.	---
748 Hamlet	---	American plum, Siberian peashrub, common chokecherry, eastern redcedar.	Blue spruce, green ash, Russian-olive.	Golden willow, green ash, Siberian elm.	Siouxland cottonwood, hybrid poplar.
749 Colvin	---	Redosier dogwood, lilac, American plum, common chokecherry, Siberian peashrub.	Red splendor crabapple, white spruce, blue spruce.	Golden willow	Siouxland cottonwood.
767 Auganaush	---	Common chokecherry, Siberian peashrub, American plum, redosier dogwood.	Blue spruce, Amur maple, northern whitecedar, white spruce.	Green ash, Norway spruce, golden willow.	Hybrid poplar, silver maple.
775B, 775C: Sugarbush	Late lilac	American plum, Amur maple, bur oak, common chokecherry, eastern redcedar, Manchurian crabapple, red splendor crabapple, silver buffaloberry.	Blue spruce, jack pine, Siberian elm, white spruce.	Green ash, silver maple, red pine.	Siouxland cottonwood.
Two Inlets	---	Lilac, eastern redcedar, Siberian peashrub, bur oak, honeysuckle.	Jack pine	Red pine	---
776B, 776C, 776E: Snellman	Peking cotoneaster	American cranberrybush, American plum, lilac, Amur maple, common chokecherry, Siberian peashrub, arrowwood, silver buffaloberry.	Eastern redcedar, hackberry, blue spruce, white spruce, red splendor crabapple, northern whitecedar.	Eastern white pine, green ash, Siberian elm, red pine, silver maple.	Siouxland cottonwood.
Sugarbush	Late lilac	American plum, Amur maple, bur oak, common chokecherry, eastern redcedar, red splendor crabapple, silver buffaloberry.	Blue spruce, jack pine, Siberian elm, white spruce. white spruce.	Green ash, silver maple, red pine.	Siouxland cottonwood.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
827B, 827C2:					
Heimdal	Nanking cherry	American plum, Siberian peashrub, lilac, silver buffaloberry.	Black Hills spruce, blue spruce, hackberry.	Green ash, silver maple.	Siouxland cottonwood, hybrid poplar.
Esmond	American plum, lilac.	Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, hackberry.	Green ash	Siouxland cottonwood.	---
867B:					
Graycalm	---	Lilac, Siberian peashrub, eastern redcedar, Manchurian crabapple, Siberian crabapple.	Jack pine, green ash.	Siberian elm, eastern white pine, red pine.	---
Menahga	---	Eastern redcedar, lilac, Siberian peashrub, Manchurian crabapple, Siberian crabapple.	Jack pine, green ash.	Eastern white pine, Siberian elm, red pine.	---
903B, 903C2:					
Barnes	Buffaloberry	Eastern redcedar, Siberian peashrub, American plum, lilac.	Blue spruce, ponderosa pine, red splendor crabapple, bur oak.	Green ash, honeylocust.	Siberian elm, Siouxland cottonwood, hybrid poplar.
Langhei	Lilac, Siberian peashrub, buffaloberry, late lilac.	Eastern redcedar, Rocky Mountain juniper, hackberry.	Siberian elm, green ash.	Siouxland cottonwood.	---
942D2:					
Langhei	Lilac, Siberian peashrub, buffaloberry, late lilac.	Eastern redcedar, Rocky Mountain juniper, hackberry.	Green ash, bur oak.	Siberian elm	---
Barnes	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Blue spruce, ponderosa pine, red splendor crabapple, northern whitecedar.	Green ash, honeylocust.	Siberian elm, Siouxland cottonwood.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
967B, 967C2: Waukon	---	American cranberrybush, hedge cotoneaster, arrowwood, Siberian peashrub, late lilac, Amur maple.	Nannyberry viburnum, red splendor crabapple, hackberry, northern whitecedar, blue spruce, white spruce.	Silver maple, Norway spruce, green ash, red pine.	Siouxland cottonwood, hybrid poplar.
Langhei	Lilac, Siberian peashrub, buffaloberry, late lilac.	Eastern redcedar, Rocky Mountain juniper, hackberry.	Green ash, bur oak.	Siberian elm	---
979D2: Langhei	Lilac, Siberian peashrub, buffaloberry, late lilac.	Eastern redcedar, Rocky Mountain juniper, hackberry.	Green ash, bur oak.	Siberian elm	---
Waukon	---	American cranberrybush, hedge cotoneaster, arrowwood, birchleaf buckthorn, gray dogwood, redosier dogwood, Siberian peashrub, late lilac, Amur maple.	Nannyberry viburnum, Manchurian crabapple, hackberry, northern whitecedar, blue spruce, white spruce.	Silver maple, Norway spruce, green ash, red pine.	Siouxland cottonwood, hybrid poplar.
1117 Hedman	Redosier dogwood	Siberian peashrub, common chokecherry, lilac.	Blue spruce, white spruce, eastern redcedar.	Green ash, golden willow, Siberian elm.	Siouxland cottonwood.
1139 Marysland	---	Redosier dogwood, Siberian peashrub, common chokecherry, lilac.	Green ash, white spruce.	Golden willow	Siouxland cottonwood, Siberian elm.
1142: Hedman	Redosier dogwood	Siberian peashrub, common chokecherry, lilac.	Blue spruce, white spruce, eastern redcedar.	Green ash, golden willow, Siberian elm.	Siouxland cottonwood.
Fram	---	Siberian peashrub, blue spruce, eastern redcedar, lilac, American plum.	Hackberry, red splendor crabapple.	Golden willow, green ash.	Siouxland cottonwood.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1148:					
Fairdale	---	Eastern redcedar, common chokecherry, Siberian peashrub, redosier dogwood, American plum.	Green ash, Black Hills spruce.	Golden willow	Siouxland cottonwood.
Lamoure	Silver buffaloberry, lilac.	Siberian peashrub	Hackberry, blue spruce, red splendor crabapple, eastern redcedar.	Golden willow, green ash.	Siouxland cottonwood.
1149 Hamerly	---	Siberian peashrub, American plum, lilac.	Blue spruce, red splendor crabapple, eastern redcedar.	Golden willow, green ash, hackberry.	Siouxland cottonwood, Siberian elm.
1152B, 1152C, 1152E Sugarbush	Late lilac	American plum, Amur maple, bur oak, common chokecherry, eastern redcedar, northern whitecedar, red splendor crabapple, silver buffaloberry.	Blue spruce, jack pine, Siberian elm, white spruce.	Green ash, silver maple, red pine.	Siouxland cottonwood.
1200 Egglake	---	Redosier dogwood	Laurel willow, white spruce, blue spruce, Black Hills spruce.	Golden willow, eastern white pine, green ash.	Siouxland cottonwood, silver maple.
1233D2:					
Heimdal	Nanking cherry	American plum, Siberian peashrub, lilac, silver buffaloberry.	Black Hills spruce, blue spruce, hackberry.	Green ash, silver maple.	Eastern cottonwood.
Esmond	American plum, lilac.	Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, hackberry.	Green ash	Siouxland cottonwood.	---
1238E:					
Two Inlets	---	Lilac, eastern redcedar, Siberian peashrub, bur oak, honeysuckle.	Jack pine	Red pine	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1238E:					
Sugarbush	Late lilac	American plum, Amur maple, bur oak, common chokecherry, eastern redcedar, red splendor crabapple, silver buffaloberry.	Blue spruce, jack pine, Siberian elm, white spruce.	Green ash, silver maple, red pine.	Siouxland cottonwood.
1241B Sandberg	---	Common chokecherry, Black Hills spruce, Siberian peashrub, lilac, sargent crabapple, eastern redcedar.	Silver maple, Scotch pine, green ash, ponderosa pine.	Siouxland cottonwood.	---
1804 Hamre	---	---	---	Golden willow, white willow.	Hybrid poplar.
1878 Hamre	---	---	---	Golden willow, white willow.	Hybrid poplar.
1967:					
Hamerly	---	Siberian peashrub, American plum, lilac.	Blue spruce, red splendor crabapple, eastern redcedar.	Golden willow, green ash, hackberry.	Siouxland cottonwood, Siberian elm.
Vallers	---	Lilac, Siberian peashrub, common chokecherry, eastern redcedar.	White spruce, blue spruce.	Golden willow, Siberian elm.	Siouxland cottonwood.

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
33B Barnes	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
36 Flom	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
38B Waukon	Slight	Slight	Moderate: slope.	Slight	Slight.
38C Waukon	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
38E Waukon	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
40B Nebish	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
40C Nebish	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
40E Nebish	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
59 Grimstad	Slight	Slight	Slight	Slight	Slight.
63 Rockwell	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
121 Wykeham	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
125 Beltrami	Moderate: wetness.	Moderate: wetness.	Moderate: slope, small stones.	Slight	Slight.
127B Sverdrup	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
180 Gonvick	Slight	Slight	Moderate: slope.	Slight	Slight.
191 Epoufette	Severe: wetness.	Severe: wetness.	Severe: small stones, wetness.	Severe: wetness.	Severe: wetness.
205 Karlstad	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
236 Vallers	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
267B Snellman	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones.
267C Snellman	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, slope.
267E Snellman	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
290B Rothsay	Slight	Slight	Moderate: slope.	Slight	Slight.
296 Fram	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
332B Sugarbush	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
335 Urness	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
344 Quam	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
346 Talmoon	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
352B Heimdal	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
426 Foldahl	Slight	Slight	Moderate: slope.	Slight	Slight.
494B Darnen	Slight	Slight	Moderate: slope.	Slight	Slight.
540 Seelyeville	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
543 Markey	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
544 Cathro	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
718B Naytahwaush	Slight	Slight	Moderate: slope.	Slight	Slight.
718C Naytahwaush	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
718E Naytahwaush	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
737------------------- Mahkonce	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight----------	Slight.
746------------------- Haslie	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
748------------------- Hamlet	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
749------------------- Colvin	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
767------------------- Auganaush	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
775B:					
Sugarbush------------	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty.
Two Inlets-----------	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight----------	Moderate: small stones, droughty.
775C:					
Sugarbush------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
Two Inlets-----------	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight----------	Moderate: small stones, droughty, slope.
776B:					
Snellman-------------	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: large stones.
Sugarbush------------	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty.
776C:					
Snellman-------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: large stones, slope.
Sugarbush------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
776E:					
Snellman-------------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Sugarbush------------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
827B:					
Heimdal	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
Esmond	Slight	Slight	Moderate: slope.	Slight	Slight.
827C2:					
Heimdal	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Esmond	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
867B:					
Graycalm	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Severe: droughty.
Menahga	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Moderate: droughty.
903B:					
Barnes	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
Langhei	Slight	Slight	Moderate: slope.	Slight	Slight.
903C2:					
Barnes	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Langhei	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
942D2:					
Langhei	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
967B:					
Waukon	Slight	Slight	Moderate: slope.	Slight	Slight.
Langhei	Slight	Slight	Moderate: slope.	Slight	Slight.
967C2:					
Waukon	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Langhei	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
979D2:					
Langhei	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Waukon	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
1030. Pits-Udipsamments					
1113:					
Haslie	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Seelyeville	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Cathro	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1117 Hedman	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1139 Marysland	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1142:					
Hedman	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Fram	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
1147:					
Fordum	Severe: flooding, small stones, ponding.	Severe: ponding, small stones.	Severe: small stones, ponding.	Severe: ponding, small stones.	Severe: small stones, ponding, flooding.
Fairdale	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Lamoure	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
1148:					
Fairdale	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
Lamoure	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1149 Hamerly	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1152B Sugarbush	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
1152C Sugarbush	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
1152E Sugarbush	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
1200 Egglake	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
1233D2:					
Esmond	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Heimdal	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
1238E:					
Two Inlets	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.
Sugarbush	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
1241B Sandberg	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
1804 Hamre	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1825B Seelyeville	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
1878 Hamre	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1967:					
Hamerly	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
Vallers	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
33B---------------- Barnes	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
36----------------- Flom	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
38B---------------- Waukon	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
38C---------------- Waukon	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
38E---------------- Waukon	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
40B---------------- Nebish	Good	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.
40C---------------- Nebish	Fair	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.
40E---------------- Nebish	Poor	Fair	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
59----------------- Grimstad	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
63----------------- Rockwell	Fair	Fair	Good	Fair	Fair	Good	Good	Fair	Fair	Good.
121---------------- Wykeham	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor.
125---------------- Beltrami	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Poor.
127B--------------- Sverdrup	Fair	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Poor.
180---------------- Gonvick	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Poor.
191---------------- Epoufette	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Fair	Good.
205---------------- Karlstad	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
236---------------- Vallers	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
267B--------------- Snellman	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Poor.
267C--------------- Snellman	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
267E---------------- Snellman	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
290B---------------- Rothsay	Good	Good	Fair	Good	Fair	Poor	Very poor.	Good	Fair	Poor.
296---------------- Fram	Good	Good	Good	---	---	Fair	Poor	Good	---	Poor.
332B---------------- Sugarbush	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
335---------------- Urness	Fair	Fair	Fair	Poor	Very poor.	Good	Good	Fair	Poor	Poor.
344---------------- Quam	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
346---------------- Talmoon	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
352B---------------- Heimdal	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	---	Very poor.
426---------------- Foldahl	Good	Good	Good	Fair	Poor	Poor	Poor	Good	Fair	Poor.
494B---------------- Darnen	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
540---------------- Seelyeville	Poor	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
543---------------- Markey	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
544---------------- Cathro	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
718B---------------- Naytahwaush	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
718C---------------- Naytahwaush	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
718E---------------- Naytahwaush	Very poor.	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
737---------------- Mahkonce	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
746---------------- Haslie	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
748---------------- Hamlet	Good	Good	Good	---	---	Poor	Poor	Good	---	Poor.
749---------------- Colvin	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
767---------------- Auganaush	Fair	Fair	Good	Good	Good	Good	Good	Fair	Good	Good.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
775B:										
Sugarbush	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Two Inlets	Poor	Fair	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
775C:										
Sugarbush	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Two Inlets	Very poor.	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
776B:										
Snellman	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Poor.
Sugarbush	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
776C:										
Snellman	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Sugarbush	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
776E:										
Snellman	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Sugarbush	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
827B:										
Heimdal	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	---	Very poor.
Esmond	Fair	Good	Good	---	---	Poor	Very poor.	Good	---	Very poor.
827C2:										
Heimdal	Fair	Good	Good	Fair	---	Very poor.	Very poor.	Good	---	Very poor.
Esmond	Fair	Fair	Good	---	---	Very poor.	Very poor.	Fair	---	Very poor.
867B:										
Graycalm	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Menahga	Poor	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
903B:										
Barnes	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Langhei	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
903C2:										
Barnes	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Langhei	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
942D2:										
Langhei	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Barnes	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
967B:										
Waukon	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Langhei	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
967C2:										
Waukon	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Langhei	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
979D2:										
Langhei	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Waukon	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
1030. Pits-Udipsamments										
1113:										
Haslie	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Good	Good	Poor	Very poor.	Good.
Seelyeville	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
Cathro	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
1117 Hedman	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
1139 Marysland	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
1142:										
Hedman	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
Fram	Good	Good	Good	Good	Fair	Fair	Poor	Good	Good	Poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1147:										
Fordum	Very poor.	Very poor.	Poor	Fair	Fair	Good	Good	Very poor.	Fair	Good.
Fairdale	Poor	Poor	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor.
Lamoure	Very poor.	Poor	Fair	Good	Good	Fair	Fair	Poor	Good	Fair.
1148:										
Fairdale	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
Lamoure	Poor	Poor	Fair	Good	Good	Fair	Fair	Poor	Good	Fair.
1149 Hamerly	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
1152B, 1152C Sugarbush	Fair	Fair	Good	Fair	Good	Very poor.	Very poor.	Fair	Good	Very poor.
1152E Sugarbush	Poor	Fair	Good	Fair	Good	Very poor.	Very poor.	Fair	Good	Very poor.
1200 Egglake	Fair	Good	Good	Good	Good	Good	Good	Fair	Fair	Good.
1233D2:										
Esmond	Poor	Poor	Good	---	---	Very poor.	Very poor.	Poor	---	Very poor.
Heimdal	Fair	Good	Good	Fair	---	Very poor.	Very poor.	Good	---	Very poor.
1238E:										
Two Inlets	Very poor.	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Sugarbush	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
1241B Sandberg	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
1804 Hamre	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
1825B Seelyeville	Very poor.	Very poor.	Poor	Poor	Poor	Good	Fair	Poor	Poor	Fair.
1878 Hamre	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
1967:										
Hamerly	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Vallers	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
33B Barnes	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
36 Flom	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
38B Waukon	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
38C Waukon	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
38E Waukon	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
40B Nebish	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
40C Nebish	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
40E Nebish	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
59 Grimstad	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Slight.
63 Rockwell	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
121 Wykeham	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.	Slight.
125 Beltrami	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
127B Sverdrup	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
180 Gonvick	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
191 Epoufette	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
205 Karlstad	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Moderate: droughty.
236 Vallers	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
267B Snellman	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Moderate: large stones.
267C Snellman	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Moderate: shrink-swell, slope, frost action.	Moderate: large stones, slope.
267E Snellman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
290B Rothsay	Slight	Slight	Slight	Slight	Severe: frost action.	Slight.
296 Fram	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
332B Sugarbush	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
335 Urness	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
344 Quam	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
346 Talmoon	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
352B Heimdal	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
426 Foldahl	Severe: cutbanks cave.	Slight	Moderate: wetness, shrink-swell.	Slight	Severe: frost action.	Slight.
494B Darnen	Slight	Slight	Moderate: shrink-swell.	Moderate: slope.	Moderate: frost action.	Slight.
540 Seelyeville	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
543 Markey	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
544---------------- Cathro	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
718B-------------- Naytahwaush	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
718C-------------- Naytahwaush	Moderate: too clayey, slope.	Severe: shrink-swell.	Moderate: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: slope.
718E-------------- Naytahwaush	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
737--------------- Mahkonce	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
746--------------- Haslie	Severe: excess humus, wetness.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, frost action.	Severe: wetness, excess humus.
748--------------- Hamlet	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
749--------------- Colvin	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
767--------------- Auganaush	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
775B:						
Sugarbush--------	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
Two Inlets-------	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: small stones, droughty.
775C:						
Sugarbush--------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Two Inlets-------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, droughty, slope.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
776B:						
Snellman	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Moderate: large stones.
Sugarbush	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
776C:						
Snellman	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Moderate: shrink-swell, slope, frost action.	Moderate: large stones, slope.
Sugarbush	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
776E:						
Snellman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sugarbush	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
827B:						
Heimdal	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
Esmond	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
827C2:						
Heimdal	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Esmond	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
867B:						
Graycalm	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
Menahga	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
903B:						
Barnes	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
Langhei	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
903C2:						
Barnes	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
903C2:						
Langhei----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
942D2:						
Langhei----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Barnes-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
967B:						
Waukon-----------	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength, frost action.	Slight.
Langhei----------	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength, frost action.	Slight.
967C2:						
Waukon-----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
Langhei----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
979D2:						
Langhei----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Waukon-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1030. Pits-Udipsamments						
1113:						
Haslie-----------	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
Seelyeville------	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Cathro-----------	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
1117------------- Hedman	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1139-------------- Marysland	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
1142:						
Hedman-----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Fram-------------	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
1147:						
Fordum-----------	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: small stones, ponding, flooding.
Fairdale---------	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Lamoure----------	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
1148:						
Fairdale---------	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Lamoure----------	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
1149-------------- Hamerly	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.	Slight.
1152B------------- Sugarbush	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
1152C------------- Sugarbush	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
1152E------------- Sugarbush	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1200-------------- Egglake	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
1233D2:						
Esmond-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Heimdal----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1238E:						
Two Inlets--------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sugarbush---------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1244B------------- Sandberg	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
1804-------------- Hamre	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
1825B------------- Seelyeville	Severe: excess humus, wetness.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness.	Severe: subsides, wetness, frost action.	Severe: wetness, excess humus.
1878-------------- Hamre	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
1967:						
Hamerly----------	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.	Slight.
Vallers----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
33B Barnes	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
36 Flom	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
38B Waukon	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
38C Waukon	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
38E Waukon	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
40B Nebish	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
40C Nebish	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
40E Nebish	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
59 Grimstad	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: wetness.
63 Rockwell	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
121 Wykeham	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
125 Beltrami	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
127B Sverdrup	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
180 Gonvick	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
191----------------- Epoufette	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
205----------------- Karlstad	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
236----------------- Vallers	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
267B---------------- Snellman	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
267C---------------- Snellman	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
267E---------------- Snellman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
290B---------------- Rothsay	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
296----------------- Fram	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
332B---------------- Sugarbush	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
335----------------- Urness	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
344----------------- Quam	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
346----------------- Talmoon	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
352B---------------- Heimdal	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
426----------------- Foldahl	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: too clayey, small stones, wetness.
494B---------------- Darnen	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
540 Seelyeville	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
543 Markey	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
544 Cathro	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
718B Naytahwaush	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
718C Naytahwaush	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
718E Naytahwaush	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
737 Mahkonce	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
746 Haslie	Severe: wetness, percs slowly.	Severe: seepage, excess humus.	Severe: wetness, excess humus.	Severe: seepage, wetness.	Poor: hard to pack, wetness.
748 Hamlet	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
749 Colvin	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
767 Auganaush	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
775B: Sugarbush	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Two Inlets	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
775C:					
Sugarbush	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Two Inlets	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
776B:					
Snellman	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Sugarbush	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
776C:					
Snellman	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Sugarbush	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
776E:					
Snellman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Sugarbush	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
827B:					
Heimdal	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Esmond	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
827C2:					
Heimdal	Moderate: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Esmond	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
867B:					
Graycalm	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
867B:					
Menahga	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
903B:					
Barnes	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Langhei	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
903C2:					
Barnes	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Langhei	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
942D2:					
Langhei	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
967B:					
Waukon	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Langhei	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
967C2:					
Waukon	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope.
Langhei	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope.
979D2:					
Langhei	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Waukon	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
1030. Pits-Udipsamments					
1113:					
Haslie	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: hard to pack, ponding.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1113:					
Seelyeville	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Cathro	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
1117 Hedman	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1139 Marysland	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
1142:					
Hedman	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Fram	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
1147:					
Fordum	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, ponding.
Fairdale	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Lamoure	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
1148:					
Fairdale	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Lamoure	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
1149 Hamerly	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
1152B Sugarbush	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
1152C Sugarbush	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1152E--------------- Sugarbush	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
1200---------------- Egglake	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1233D2:					
Esmond-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Heimdal------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
1238E:					
Two Inlets---------	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Sugarbush----------	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
1241B--------------- Sandberg	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
1804---------------- Hamre	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
1825B--------------- Seelyeville	Severe: subsides, wetness, percs slowly.	Severe: seepage, excess humus.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.
1878---------------- Hamre	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
1967:					
Hamerly------------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Vallers------------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
33B Barnes	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
36 Flom	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
38B Waukon	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
38C Waukon	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
38E Waukon	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
40B Nebish	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
40C Nebish	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
40E Nebish	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
59 Grimstad	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
63 Rockwell	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
121 Wykeham	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
125 Beltrami	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
127B Sverdrup	Good	Probable	Improbable: too sandy.	Poor: too sandy.
180 Gonvick	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
191 Epoufette	Poor: wetness.	Probable	Probable	Poor: too sandy, small stones, area reclaim.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
205 Karlstad	Fair: wetness.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
236 Vallers	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
267B Snellman	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
267C Snellman	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
267E Snellman	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
290B Rothsay	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
296 Fram	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
332B Sugarbush	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
335 Urness	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
344 Quam	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
346 Talmoon	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
352B Heimdal	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
426 Foldahl	Fair: shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
494B Darnen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
540 Seelyeville	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
543 Markey	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
544 Cathro	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
718B, 718C Naytahwaush	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
718E Naytahwaush	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
737 Mahkonce	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
746 Haslie	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
748 Hamlet	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
749 Colvin	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
767 Auganaush	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
775B, 775C: Sugarbush	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Two Inlets	Good	Probable	Probable	Poor: small stones, area reclaim.
776B: Snellman	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Sugarbush	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
776C: Snellman	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Sugarbush	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
776E: Snellman	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
776E:				
Sugarbush	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
827B:				
Heimdal	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Esmond	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
827C2:				
Heimdal	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Esmond	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
867B:				
Graycalm	Good	Probable	Improbable: too sandy.	Poor: too sandy, small stones.
Menahga	Good	Probable	Improbable: too sandy.	Poor: too sandy.
903B:				
Barnes	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Langhei	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
903C2:				
Barnes	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Langhei	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
942D2:				
Langhei	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Barnes	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
967B:				
Waukon	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Langhei	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
967C2:				
Waukon	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Langhei	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
979D2:				
Langhei	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Waukon	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
1030. Pits-Udipsamments				
1113:				
Haslie	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Seelyeville	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Cathro	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
1117 Hedman	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1139 Marysland	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
1142:				
Hedman	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Fram	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1147:				
Fordum	Poor: wetness.	Probable	Improbable: too sandy.	Poor: small stones, wetness.
Fairdale	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Lamoure	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1148:				
Fairdale	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Lamoure	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1149 Hamerly	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1152B, 1152C Sugarbush	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
1152E Sugarbush	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
1200 Egglake	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1233D2:				
Esmond	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Heimdal	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
1238E:				
Two Inlets	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
Sugarbush	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
1241B Sandberg	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
1804 Hamre	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1825B Seelyeville	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
1878 Hamre	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1967:				
Hamerly	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Vallers	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
33B Barnes	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Erodes easily	Erodes easily.
36 Flom	Slight	Severe: wetness.	Severe: slow refill.	Frost action	Wetness	Wetness	Wetness.
38B Waukon	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope	Favorable	Favorable.
38C, 38E Waukon	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope	Slope	Slope.
40B Nebish	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Favorable	Favorable.
40C, 40E Nebish	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Slope	Slope.
59 Grimstad	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Favorable	Wetness	Erodes easily, wetness, soil blowing.	Erodes easily.
63 Rockwell	Severe: seepage.	Severe: piping, wetness.	Severe: slow refill, cutbanks cave.	Frost action	Wetness	Wetness	Wetness.
121 Wykeham	Moderate: seepage.	Moderate: wetness.	Severe: cutbanks cave.	Favorable	Wetness, soil blowing.	Wetness, soil blowing.	Rooting depth.
125 Beltrami	Moderate: seepage.	Severe: piping.	Severe: slow refill, cutbanks cave.	Frost action	Wetness	Wetness	Favorable.
127B Sverdrup	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
180 Gonvick	Moderate: seepage.	Severe: piping.	Severe: slow refill.	Frost action	Wetness	Wetness	Favorable.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
191--------------- Epoufette	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
205--------------- Karlstad	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Large stones, wetness, too sandy.	Large stones, droughty.
236--------------- Vallers	Slight---------	Severe: piping, wetness.	Severe: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.
267B-------------- Snellman	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Slope, soil blowing, rooting depth.	Soil blowing---	Rooting depth.
267C, 267E-------- Snellman	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope, soil blowing, rooting depth.	Slope, soil blowing.	Slope, rooting depth.
290B-------------- Rothsay	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
296--------------- Fram	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Frost action---	Wetness--------	Erodes easily, wetness.	Erodes easily.
332B-------------- Sugarbush	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty, rooting depth.
335--------------- Urness	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.
344--------------- Quam	Slight---------	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Erodes easily, ponding.	Wetness, erodes easily.
346--------------- Talmoon	Slight---------	Severe: piping, wetness.	Severe: slow refill.	Frost action---	Wetness--------	Erodes easily, wetness.	Wetness, erodes easily.
352B-------------- Heimdal	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Favorable------	Rooting depth.
426--------------- Foldahl	Severe: seepage.	Severe: piping.	Severe: slow refill, cutbanks cave.	Frost action---	Wetness--------	Erodes easily, wetness, soil blowing.	Erodes easily.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
494B Darnen	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Erodes easily	Erodes easily.
540 Seelyeville	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
543 Markey	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
544 Cathro	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
718B Naytahwaush	Moderate: slope.	Slight	Severe: no water.	Deep to water	Slope, percs slowly.	Favorable	Percs slowly.
718C, 718E Naytahwaush	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope, percs slowly.	Slope	Slope, percs slowly.
737 Mahkonce	Slight	Moderate: wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness	Wetness	Percs slowly.
746 Haslie	Severe: seepage.	Severe: excess humus, wetness.	Severe: slow refill.	Percs slowly, subsides, frost action.	Wetness, soil blowing, percs slowly.	Wetness, soil blowing, percs slowly.	Wetness, percs slowly.
748 Hamlet	Moderate: seepage.	Severe: piping.	Severe: slow refill.	Frost action	Percs slowly	Percs slowly	Favorable.
749 Colvin	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
767 Auganaush	Slight	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
775B:							
Sugarbush	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty, rooting depth.
Two Inlets	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty, rooting depth.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
775C:							
Sugarbush	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
Two Inlets	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
776B:							
Snellman	Moderate: seepage, slope.	Slight	Severe: no water.	Deep to water	Slope, soil blowing, rooting depth.	Soil blowing	Rooting depth.
Sugarbush	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty, rooting depth.
776C, 776E:							
Snellman	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope, soil blowing, rooting depth.	Slope, soil blowing.	Slope, rooting depth.
Sugarbush	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
827B:							
Heimdal	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Favorable	Favorable.
Esmond	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Erodes easily	Erodes easily.
827C2:							
Heimdal	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Slope	Slope.
Esmond	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
867B:							
Graycalm	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
867B:							
Menahga----------	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
903B:							
Barnes-----------	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Langhei----------	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Favorable------	Favorable.
903C2:							
Barnes-----------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Langhei----------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.
942D2:							
Langhei----------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.
Barnes-----------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
967B:							
Waukon-----------	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Favorable------	Favorable.
Langhei----------	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Favorable------	Favorable.
967C2:							
Waukon-----------	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.
Langhei----------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.
979D2:							
Langhei----------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
979D2: Waukon-----------	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.
1030. Pits-Udipsamments							
1113: Haslie-----------	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, percs slowly, subsides.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
Seelyeville------	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.
Cathro-----------	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.
1117-------------- Hedman	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.
1139-------------- Marysland	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, frost action, cutbanks cave.	Wetness, flooding.	Wetness, too sandy.	Wetness.
1142: Hedman-----------	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.
Fram-------------	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Frost action---	Wetness--------	Erodes easily, wetness.	Erodes easily.
1147: Fordum-----------	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, flooding, frost action.	Ponding, droughty, flooding.	Erodes easily, ponding, too sandy.	Wetness, erodes easily, droughty.
Fairdale---------	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable------	Favorable------	Favorable.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1147:							
Lamoure	Moderate: seepage.	Severe: hard to pack, wetness.	Severe: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
1148:							
Fairdale	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable	Favorable	Favorable.
Lamoure	Moderate: seepage.	Severe: hard to pack, wetness.	Severe: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
1149 Hamerly	Slight	Severe: piping.	Severe: slow refill.	Frost action	Wetness	Erodes easily, wetness.	Erodes easily.
1152B Sugarbush	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty, rooting depth.
1152C, 1152E Sugarbush	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
1200 Egglake	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action	Wetness, rooting depth.	Wetness	Wetness, rooting depth.
1233D2:							
Esmond	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Heimdal	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Slope	Slope.
1238E:							
Two Inlets	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
Sugarbush	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
1241B Sandberg	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1804-------------- Hamre	Moderate: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
1825B------------- Seelyeville	Severe: seepage.	Severe: excess humus, wetness.	Severe: slow refill.	Subsides, frost action, slope.	Slope, wetness.	Wetness--------	Wetness.
1878-------------- Hamre	Moderate: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
1967: Hamerly----------	Slight---------	Severe: piping.	Severe: slow refill.	Frost action---	Wetness--------	Erodes easily, wetness.	Erodes easily.
Vallers----------	Slight---------	Severe: piping, wetness.	Severe: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
33B--------------- Barnes	0-9	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	50-90	20-40	5-20
	9-15	Loam, sandy clay loam.	CL, CL-ML, SC, SC-SM	A-4, A-6	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	15-60	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
36---------------- Flom	0-10	Silty clay loam	CL	A-7, A-6	0	95-100	95-100	90-100	80-95	35-50	15-30
	10-20	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	30-50	10-30
	20-60	Loam, clay loam	CL	A-6, A-7	0	95-100	90-100	80-95	60-90	20-50	10-30
38B--------------- Waukon	0-7	Loam-------------	ML, CL, CL-ML	A-6, A-4	0-3	95-100	90-100	80-95	60-90	20-40	5-20
	7-24	Clay loam, loam	CL, ML	A-6, A-7	0-3	95-100	90-100	75-95	50-85	30-45	10-20
	24-60	Loam, clay loam	ML, CL	A-6	0-3	95-100	90-100	70-95	50-80	30-40	10-20
38C--------------- Waukon	0-8	Loam-------------	ML, CL, CL-ML	A-6, A-4	0-3	95-100	90-100	80-95	60-90	20-40	5-20
	8-23	Clay loam, loam	CL, ML	A-6, A-7	0-3	95-100	90-100	75-95	50-85	30-45	10-20
	23-60	Loam, clay loam	ML, CL	A-6	0-3	95-100	90-100	70-95	50-80	30-40	10-20
38E--------------- Waukon	0-4	Loam-------------	ML, CL, CL-ML	A-6, A-4	0-3	95-100	90-100	80-95	60-90	20-40	5-20
	4-20	Clay loam, loam	CL, ML	A-6, A-7	0-3	95-100	90-100	75-95	50-85	30-45	10-20
	20-60	Loam, clay loam	ML, CL	A-6	0-3	95-100	90-100	70-95	50-80	30-40	10-20
40B--------------- Nebish	0-5	Loam-------------	ML	A-4	0-3	95-100	85-100	85-95	50-70	20-40	1-10
	5-24	Clay loam, loam	CL, ML	A-6, A-7	0-3	95-100	85-100	70-95	55-80	30-50	10-20
	24-60	Loam, clay loam	CL, ML	A-4, A-6	0-3	95-100	85-100	70-95	50-80	20-40	5-20
40C--------------- Nebish	0-3	Loam-------------	ML	A-4	0-3	95-100	85-100	85-95	50-70	20-40	1-10
	3-23	Clay loam, loam	CL, ML	A-6, A-7	0-3	95-100	85-100	70-95	55-80	30-50	10-20
	23-60	Loam, clay loam	CL, ML	A-4, A-6	0-3	95-100	85-100	70-95	50-80	20-40	5-20
40E--------------- Nebish	0-2	Loam-------------	ML	A-4	0-3	95-100	85-100	85-95	50-70	20-40	1-10
	2-22	Clay loam, loam	CL, ML	A-6, A-7	0-3	95-100	85-100	70-95	55-80	30-50	10-20
	22-60	Loam, clay loam	CL, ML	A-4, A-6	0-3	95-100	85-100	70-95	50-80	20-40	5-20
59---------------- Grimstad	0-8	Sandy loam-------	SM, SC-SM	A-4, A-2	0	100	100	80-100	15-50	15-30	NP-7
	8-39	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-90	5-35	<25	NP-4
	39-60	Sandy loam, fine sandy loam, loam.	SC, CL, SC-SM, CL-ML	A-4, A-6	0-3	95-100	85-100	70-90	40-85	15-40	5-20
63---------------- Rockwell	0-9	Loam-------------	OL, ML	A-4	0	100	95-100	85-95	50-75	20-40	NP-10
	9-27	Fine sandy loam, sandy loam, loam.	SM, ML, SC-SM, CL-ML	A-4	0	100	95-100	60-85	35-55	15-25	1-7
	27-34	Fine sand, sand, loamy fine sand.	SM	A-2	0	100	95-100	65-80	20-35	---	NP
	34-60	Silt loam, loam, clay loam.	CL, CL-ML, SC, SC-SM	A-6, A-4	0-1	95-100	90-100	70-90	40-85	15-40	5-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
121-------------- Wykeham	0-6	Fine sandy loam	SM, SC-SM	A-4	0-5	90-100	85-100	65-80	40-50	25-30	2-5
	6-10	Fine sandy loam, loamy sand, sandy loam.	SM, SC-SM	A-4, A-2	0-5	85-100	70-95	65-80	25-50	<20	1-5
	10-30	Loam, sandy clay loam, sandy loam.	SC, CL	A-6	0-5	90-100	85-95	70-80	35-60	30-35	10-15
	30-60	Fine sandy loam, sandy loam.	SC-SM, SC	A-4	0-5	85-95	85-95	65-80	35-50	20-25	5-10
125-------------- Beltrami	0-4	Loam-------------	ML, CL, CL-ML	A-4	0-3	95-100	85-95	75-95	50-65	20-30	3-10
	4-9	Fine sandy loam, loam, loamy sand.	SM, SC-SM, ML, CL-ML	A-4, A-2	0-3	95-100	85-95	60-90	25-60	<25	NP-7
	9-36	Loam, sandy clay loam, clay loam.	CL	A-6, A-7	0-3	95-100	85-98	75-95	50-85	20-45	10-30
	36-60	Loam, clay loam	CL-ML, CL	A-4, A-6	1-3	95-100	85-95	70-95	50-80	20-40	5-20
127B------------- Sverdrup	0-10	Sandy loam-------	SM	A-4	0	100	95-100	60-70	35-50	20-30	NP-10
	10-27	Loam, sandy loam, loamy sand.	ML, SM	A-2, A-4	0	100	95-100	50-75	30-70	<30	NP-5
	27-60	Sand, fine sand	SP, SP-SM	A-3, A-2	0	100	93-100	50-90	2-10	<20	NP-5
180-------------- Gonvick	0-10	Loam-------------	ML, CL, CL-ML	A-4, A-6	0-3	95-100	90-100	85-95	50-75	20-40	3-20
	10-25	Loam, clay loam	CL	A-6, A-7	0-3	95-100	90-100	75-95	50-85	20-50	10-30
	25-60	Loam, clay loam	CL-ML, CL	A-4, A-6	0-3	95-100	90-100	70-95	50-80	15-40	5-20
191-------------- Epoufette	0-9	Sandy loam-------	SM, SC-SM	A-2, A-4	0-5	95-100	65-95	60-75	25-40	<25	NP-7
	9-27	Loamy sand, sand, gravelly loamy sand.	SM, SP, SP-SM	A-2, A-3	0-5	95-100	65-95	50-75	0-30	---	NP
	27-35	Gravelly sandy loam, sandy loam, gravelly loamy sand.	SM, SC-SM, SC	A-2, A-4	0-5	95-100	70-95	60-80	25-40	<25	2-10
	35-60	Gravelly sand, coarse sand, sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	50-90	45-85	30-60	0-10	---	NP
205-------------- Karlstad	0-11	Sandy loam-------	SM, SC-SM, SC	A-2, A-4	0-5	95-100	95-100	75-95	12-50	<25	NP-10
	11-20	Coarse sandy loam, sandy loam, fine sandy loam.	SM, SC-SM, SC	A-2, A-4	0-5	95-100	95-100	75-95	12-50	<25	NP-10
	20-25	Gravelly coarse sandy loam, gravelly sandy loam, gravelly fine sandy loam.	SC, SM, SC-SM, SP-SM	A-2, A-1, A-3	0-25	65-95	20-85	15-70	5-35	<25	NP-10
	25-60	Stratified gravelly coarse sand to loamy fine sand.	SP, SP-SM	A-1, A-2, A-3	0-25	60-100	50-100	20-80	2-12	---	NP
236-------------- Vallers	0-9	Silty clay loam	OL, CL, ML	A-6, A-7	0	95-100	95-100	95-100	85-95	30-50	11-20
	9-19	Clay loam, silty clay loam.	CL	A-6	0	95-100	90-100	80-95	50-80	30-40	11-20
	19-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	95-100	90-100	85-95	60-85	20-40	5-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
267B------------- Snellman	0-3	Sandy loam-------	SM, SC-SM	A-4	0-10	90-100	85-100	65-80	40-50	25-30	2-5
	3-12	Loamy sand, sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2	0-10	88-100	85-100	65-80	30-50	<20	NP-5
	12-23	Sandy clay loam, sandy loam.	SC	A-6	0-10	90-100	85-95	70-80	35-50	25-40	10-20
	23-60	Sandy loam, fine sandy loam.	SC-SM, SC	A-4	0-10	85-95	85-95	65-80	35-50	<25	5-10
267C------------- Snellman	0-3	Sandy loam-------	SM, SC-SM	A-4	0-10	90-100	85-100	65-80	40-50	25-30	2-5
	3-19	Loamy sand, sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2	0-10	88-100	85-100	65-80	30-50	<20	NP-5
	19-28	Sandy clay loam, sandy loam.	SC	A-6	0-10	90-100	85-95	70-80	35-50	25-40	10-20
	28-60	Sandy loam, fine sandy loam.	SC-SM, SC	A-4	0-10	85-95	85-95	65-80	35-50	<25	5-10
267E------------- Snellman	0-3	Sandy loam-------	SM, SC-SM	A-4	0-10	90-100	85-100	65-80	40-50	25-30	2-5
	3-8	Loamy sand, sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2	0-10	88-100	85-100	65-80	30-50	<20	NP-5
	8-29	Sandy clay loam, sandy loam.	SC	A-6	0-10	90-100	85-95	70-80	35-50	25-40	10-20
	29-60	Sandy loam, fine sandy loam.	SC-SM, SC	A-4	0-10	85-95	85-95	65-80	35-50	<25	5-10
290B------------- Rothsay	0-13	Silt loam--------	ML	A-4	0	95-100	95-100	90-100	85-100	20-40	NP-10
	13-23	Silt loam, very fine sandy loam, loam.	ML	A-4	0	95-100	95-100	90-100	80-100	20-40	NP-10
	23-60	Silt loam, loam, very fine sandy loam.	ML	A-4	0	95-100	95-100	90-100	80-90	20-40	NP-10
296-------------- Fram	0-12	Loam-------------	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	12-60	Sandy loam, fine sandy loam, loam.	SM, ML	A-4	0-1	95-100	90-100	60-100	35-90	20-40	NP-10
332B------------- Sugarbush	0-3	Sandy loam-------	SM	A-2-4	0	95-100	90-100	55-70	25-35	<20	NP-4
	3-9	Loamy sand, loamy coarse sand.	SM, SP-SM	A-1-b, A-2-4	0	95-100	90-100	40-70	10-25	---	NP
	9-24	Sandy loam, coarse sandy loam.	SM	A-2-4	0	95-100	90-100	50-70	25-35	<20	NP-4
	24-60	Gravelly coarse sand, gravelly sand.	SP, SP-SM	A-1-b, A-2-4, A-3	0-5	55-85	50-75	30-55	2-10	---	NP
335-------------- Urness	0-12	Mucky silt loam	OL, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-95	20-50	3-20
	12-60	Mucky silt loam, mucky silty clay loam, silty clay loam.	ML, CL, CL-ML, OL	A-4, A-6, A-7	0	95-100	90-100	85-100	70-95	20-50	3-30

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
344 Quam	0-9	Silty clay loam	CL, ML, OL	A-7	0	100	100	90-100	85-95	40-50	15-25
	9-44	Silty clay loam, silt loam, loam.	CL, ML	A-7, A-6, A-4	0	100	100	80-100	70-95	30-50	5-25
	44-60	Clay loam, silty clay loam, silt loam.	CL, ML, CL-ML	A-4, A-6, A-7	0	100	90-100	85-95	70-90	20-50	5-20
346 Talmoon	0-5	Loam	ML, CL, CL-ML	A-4	0-2	95-100	85-100	70-100	60-90	20-32	3-10
	5-13	Very fine sandy loam, sandy loam, loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0-2	95-100	85-100	60-95	35-75	23-35	6-15
	13-25	Clay loam, silty clay loam, loam.	CL, ML	A-6, A-7, A-4	0-2	95-100	85-100	70-100	50-95	30-50	9-20
	25-60	Loam, sandy clay loam, clay loam.	CL, CL-ML, SC, SC-SM	A-6, A-4, A-7	0-2	95-100	85-100	75-100	45-80	25-45	6-18
352B Heimdal	0-8	Loam	ML, CL, CL-ML	A-4, A-6	0-1	95-100	85-95	55-85	50-70	20-35	3-15
	8-17	Loam, fine sandy loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	95-100	85-95	50-80	35-65	15-30	3-15
	17-32	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	95-100	85-95	50-80	35-65	15-30	2-12
	32-60	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-3	95-100	85-95	50-80	35-65	15-30	2-12
426 Foldahl	0-8	Sandy loam	SM, ML	A-4	0	100	95-100	70-85	35-60	<20	NP-4
	8-30	Fine sand, loamy fine sand, sand.	SP-SM, SM	A-2, A-3	0-3	95-100	90-100	70-85	5-35	---	NP
	30-60	Loam, clay loam, sandy loam.	CL-ML, CL, SC-SM, SC	A-4, A-6	1-5	95-100	75-95	70-90	40-85	15-40	5-20
494B Darnen	0-28	Loam	ML, CL, CL-ML	A-4	0	100	100	85-100	60-90	20-35	2-10
	28-38	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-90	20-45	5-25
	38-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	90-100	90-100	80-95	60-85	20-45	5-25
540 Seelyeville	0-44	Muck	PT	A-8	0	---	---	---	---	---	---
	44-60	Muck, mucky-peat	PT	A-8	0	---	---	---	---	---	---
543 Markey	0-28	Muck	PT	A-8	---	---	---	---	---	---	---
	28-60	Sand, loamy sand, fine sand.	SP, SM, SP-SM	A-2, A-3	0	100	75-100	60-75	0-20	---	NP
544 Cathro	0-15	Muck	PT	A-8	0	---	---	---	---	---	---
	15-24	Sapric material	PT	A-8	0	---	---	---	---	---	---
	24-60	Sandy loam, loam, clay loam.	SM, ML, SC, CL	A-4, A-6	0-5	85-100	75-100	60-100	35-90	20-40	5-20
718B Naytahwaush	0-4	Loam	CL, ML	A-6	0-5	95-100	90-100	75-90	60-90	30-40	10-15
	4-8	Loam, silt loam, fine sandy loam.	CL, ML	A-4, A-6	0-5	95-100	90-100	65-90	50-80	25-40	5-20
	8-32	Clay, silty clay, clay loam.	CL, CH	A-7	0-5	95-100	90-100	75-95	70-90	45-65	25-40
	32-60	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0-5	95-100	90-100	75-95	60-90	35-50	15-25

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
718C------------- Naytahwaush	0-5	Loam-------------	CL, ML	A-6	0-5	95-100	90-100	75-90	60-90	30-40	10-15
	5-8	Loam, silt loam, fine sandy loam.	CL, ML	A-4, A-6	0-5	95-100	90-100	65-90	50-80	25-40	5-20
	8-22	Clay, silty clay, clay loam.	CL, CH	A-7	0-5	95-100	90-100	75-95	70-90	45-65	25-40
	22-60	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0-5	95-100	90-100	75-95	60-90	35-50	15-25
718E------------- Naytahwaush	0-3	Loam-------------	CL, ML	A-6	0-5	95-100	90-100	75-90	60-90	30-40	10-15
	3-6	Loam, silt loam, fine sandy loam.	CL, ML	A-4, A-6	0-5	95-100	90-100	65-90	50-80	25-40	5-20
	6-20	Clay, silty clay, clay loam.	CL, CH	A-7	0-5	95-100	90-100	75-95	70-90	45-65	25-40
	20-60	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0-5	95-100	90-100	75-95	60-90	35-50	15-25
737-------------- Mahkonce	0-4	Loam-------------	CL, ML	A-6, A-7	0-5	95-100	90-100	75-95	60-90	35-50	15-25
	4-10	Fine sandy loam, loam, silt loam.	CL, ML	A-4, A-6	0-5	95-100	90-100	65-90	50-80	30-40	10-20
	10-26	Silty clay, clay	CH	A-7	0-5	95-100	90-100	75-95	70-90	50-65	25-40
	26-60	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0-5	95-100	90-100	75-95	60-90	35-50	15-25
746-------------- Haslie	0-42	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	42-60	Coprogenous earth	OL	A-5	0	100	95-100	85-100	75-96	41-50	2-10
748-------------- Hamlet	0-12	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-95	60-75	20-40	5-25
	12-20	Loam, clay loam	CL, CL-ML	A-6, A-7, A-4	0-5	95-100	90-100	85-100	60-80	25-45	5-25
	20-60	Loam, clay loam	CL, CL-ML	A-6, A-7, A-4	0-5	95-100	90-100	85-100	60-80	25-45	5-25
749-------------- Colvin	0-9	Silt loam--------	CL	A-6	0	100	95-100	90-100	80-95	30-45	10-25
	9-28	Silt loam, silty clay loam.	CL	A-6	0	100	95-100	90-100	80-95	30-45	10-25
	28-52	Silt loam, silty clay loam.	CL	A-6	0	100	95-100	90-100	80-95	30-45	10-25
	52-60	Stratified fine sandy loam to silty clay loam.	ML, CL	A-4, A-6	0	90-100	90-100	80-95	60-90	25-50	8-30
767-------------- Auganaush	0-5	Loam-------------	CL, ML, CL-ML	A-4, A-6	0-5	95-100	90-99	85-95	60-90	20-40	5-15
	5-8	Loam, fine sandy loam, silt loam.	SM, CL-ML, ML, SC-SM	A-4	0-5	95-100	85-99	75-90	40-70	<30	NP-10
	8-22	Clay, clay loam, silty clay loam.	CL, CH, MH	A-7	0-5	95-100	90-99	85-100	70-90	45-70	25-45
	22-60	Clay loam, silty clay loam, silty clay.	CL, ML, CH	A-6, A-7	0-5	95-100	85-99	80-95	60-90	35-55	15-30
775B:											
Sugarbush-------	0-4	Sandy loam-------	SM	A-2-4	0	95-100	90-100	55-70	25-35	<20	NP-4
	4-9	Loamy sand, loamy coarse sand.	SM, SP-SM	A-1-b, A-2-4	0	95-100	90-100	40-70	10-25	---	NP
	9-27	Sandy loam, coarse sandy loam.	SM	A-2-4	0	95-100	90-100	50-70	25-35	<20	NP-4
	27-60	Gravelly coarse sand, gravelly sand.	SP, SP-SM	A-1-b, A-2-4, A-3	0-5	55-85	50-75	30-55	2-10	---	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
775B:											
Two Inlets------	0-2	Coarse sandy loam	SM, SP-SM	A-1, A-2, A-3, A-4	0-2	80-98	65-95	60-80	15-30	---	NP-4
	2-8	Loamy coarse sand, gravelly loamy coarse sand.	SP-SM	A-1, A-3	0-2	80-98	65-95	60-80	15-30	---	NP-4
	8-27	Loamy coarse sand, gravelly loamy coarse sand.	SP-SM	A-1, A-3	0-5	80-98	65-95	60-80	15-30	<25	NP-7
	27-60	Gravelly coarse sand.	SP, SP-SM	A-1, A-3	0-5	70-93	50-85	30-55	2-10	---	NP
775C:											
Sugarbush-------	0-3	Sandy loam-------	SM	A-2-4	0	95-100	90-100	55-70	25-35	<20	NP-4
	3-10	Loamy sand, loamy coarse sand.	SM, SP-SM	A-1-b, A-2-4	0	95-100	90-100	40-70	10-25	---	NP
	10-27	Sandy loam, coarse sandy loam.	SM	A-2-4	0	95-100	90-100	50-70	25-35	<20	NP-4
	27-60	Gravelly coarse sand, gravelly sand.	SP, SP-SM	A-1-b, A-2-4, A-3	0-5	55-85	50-75	30-55	2-10	---	NP
Two Inlets------	0-3	Coarse sandy loam	SM, SP-SM	A-1, A-2, A-3, A-4	0-2	80-98	65-95	60-80	15-30	---	NP-4
	3-9	Loamy coarse sand, gravelly loamy coarse sand.	SP-SM	A-1, A-3	0-2	80-98	65-95	60-80	15-30	---	NP-4
	9-29	Loamy coarse sand, gravelly loamy coarse sand.	SP-SM	A-1, A-3	0-5	80-98	65-95	60-80	15-30	<25	NP-7
	29-60	Gravelly coarse sand.	SP, SP-SM	A-1, A-3	0-5	70-93	50-85	30-55	2-10	---	NP
776B:											
Snellman--------	0-2	Sandy loam-------	SM, SC-SM	A-4	0-10	90-100	85-100	65-80	40-50	25-30	2-5
	2-18	Loamy sand, sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2	0-10	88-100	85-100	65-80	30-50	<20	NP-5
	18-33	Sandy clay loam, sandy loam.	SC	A-6	0-10	90-100	85-95	70-80	35-50	25-40	10-20
	33-60	Sandy loam, fine sandy loam.	SC-SM, SC	A-4	0-10	85-95	85-95	65-80	35-50	<25	5-10
Sugarbush-------	0-3	Sandy loam-------	SM	A-2-4	0	95-100	90-100	55-70	25-35	<20	NP-4
	3-13	Loamy sand, loamy coarse sand.	SM, SP-SM	A-1-b, A-2-4	0	95-100	90-100	40-70	10-25	---	NP
	13-35	Sandy loam, coarse sandy loam.	SM	A-2-4	0	95-100	90-100	50-70	25-35	<20	NP-4
	35-60	Gravelly coarse sand, gravelly sand.	SP, SP-SM	A-1-b, A-2-4, A-3	0-5	55-85	50-75	30-55	2-10	---	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
776C:											
Snellman	0-2	Fine sandy loam	SM, SC-SM	A-4	0-10	90-100	85-100	65-80	40-50	25-30	2-5
	2-18	Loamy sand, sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2	0-10	88-100	85-100	65-80	30-50	<20	NP-5
	18-26	Sandy clay loam, sandy loam.	SC	A-6	0-10	90-100	85-95	70-80	35-50	25-40	10-20
	26-60	Sandy loam, fine sandy loam.	SC-SM, SC	A-4	0-10	85-95	85-95	65-80	35-50	<25	5-10
Sugarbush	0-2	Sandy loam	SM	A-2-4	0	95-100	90-100	55-70	25-35	<20	NP-4
	2-12	Loamy sand, loamy coarse sand.	SM, SP-SM	A-1-b, A-2-4	0	95-100	90-100	40-70	10-25	---	NP
	12-25	Sandy loam, coarse sandy loam.	SM	A-2-4	0	95-100	90-100	50-70	25-35	<20	NP-4
	25-60	Gravelly coarse sand, gravelly sand.	SP, SP-SM	A-1-b, A-2-4, A-3	0-5	55-85	50-75	30-55	2-10	---	NP
776E:											
Snellman	0-2	Sandy loam	SM, SC-SM	A-4	0-10	90-100	85-100	65-80	40-50	25-30	2-5
	2-12	Loamy sand, sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2	0-10	88-100	85-100	65-80	30-50	<20	NP-5
	12-22	Sandy clay loam, sandy loam.	SC	A-6	0-10	90-100	85-95	70-80	35-50	25-40	10-20
	22-60	Sandy loam, fine sandy loam.	SC-SM, SC	A-4	0-10	85-95	85-95	65-80	35-50	<25	5-10
Sugarbush	0-1	Sandy loam	SM	A-2-4	0	95-100	90-100	55-70	25-35	<20	NP-4
	1-9	Loamy sand, loamy coarse sand.	SM, SP-SM	A-1-b, A-2-4	0	95-100	90-100	40-70	10-25	---	NP
	9-22	Sandy loam, coarse sandy loam.	SM	A-2-4	0	95-100	90-100	50-70	25-35	<20	NP-4
	22-60	Gravelly coarse sand, gravelly sand.	SP, SP-SM	A-1-b, A-2-4, A-3	0-5	55-85	50-75	30-55	2-10	---	NP
827B:											
Heimdal	0-8	Loam	ML, CL, CL-ML	A-4, A-6	0-1	95-100	85-95	55-85	50-70	20-35	3-15
	8-17	Loam, fine sandy loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	95-100	85-95	50-80	35-65	15-30	3-15
	17-30	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	95-100	85-95	50-80	35-65	15-30	2-12
	30-60	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-3	95-100	85-95	50-80	35-65	15-30	2-12
Esmond	0-7	Loam	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	7-60	Loam, sandy loam, fine sandy loam.	ML, SM, SC, CL	A-4, A-6	0-5	90-100	85-100	60-100	35-90	20-40	NP-15

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
827C2:											
Heimdal----------	0-8	Loam-------------	ML, CL, CL-ML	A-4, A-6	0-1	95-100	85-95	55-85	50-70	20-35	3-15
	8-15	Loam, fine sandy loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	95-100	85-95	50-80	35-65	15-30	3-15
	15-26	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	95-100	85-95	50-80	35-65	15-30	2-12
	26-60	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-3	95-100	85-95	50-80	35-65	15-30	2-12
Esmond-----------	0-8	Loam-------------	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-60	Loam, sandy loam, fine sandy loam.	ML, SM, SC, CL	A-4, A-6	0-5	90-100	85-100	60-100	35-90	20-40	NP-15
867B:											
Graycalm---------	0-2	Loamy sand-------	SP-SM, SM	A-2, A-1	0-5	95-100	75-100	35-75	10-30	---	NP
	2-18	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0-5	95-100	75-100	30-75	0-30	---	NP
	18-60	Sand, loamy sand, loamy coarse sand.	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	30-75	0-30	---	NP
Menahga----------	0-8	Loamy sand-------	SM, SP-SM	A-2	0	100	85-100	60-80	10-30	---	NP
	8-22	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
	22-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
903B:											
Barnes-----------	0-7	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	50-90	20-40	5-20
	7-14	Loam, sandy clay loam.	CL, CL-ML, SC, SC-SM	A-4, A-6	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	14-60	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Langhei----------	0-5	Loam-------------	CL-ML, CL	A-4, A-6	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	5-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
	19-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
903C2:											
Barnes-----------	0-6	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	50-90	20-40	5-20
	6-11	Loam, sandy clay loam.	CL, CL-ML, SC, SC-SM	A-4, A-6	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	11-60	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Langhei----------	0-4	Loam-------------	CL-ML, CL	A-4, A-6	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	4-32	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
	32-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
942D2:											
Langhei----------	0-6	Loam-------------	CL-ML, CL	A-4, A-6	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	6-26	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
	26-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
Barnes-----------	0-7	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	50-90	20-40	5-20
	7-13	Loam, sandy clay loam.	CL, CL-ML, SC, SC-SM	A-4, A-6	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	13-60	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
967B:											
Waukon----------	0-6	Loam-------------	ML, CL, CL-ML	A-6, A-4	0-3	95-100	90-100	80-95	60-90	20-40	5-20
	6-20	Clay loam, loam	CL, ML	A-6, A-7	0-3	95-100	90-100	75-95	50-85	30-45	10-20
	20-60	Loam, clay loam	ML, CL	A-6	0-3	95-100	90-100	70-95	50-80	30-40	10-20
Langhei---------	0-6	Loam-------------	CL-ML, CL	A-4, A-6	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	6-39	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
	39-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
967C2:											
Waukon----------	0-6	Loam-------------	ML, CL, CL-ML	A-6, A-4	0-3	95-100	90-100	80-95	60-90	20-40	5-20
	6-15	Clay loam, loam	CL, ML	A-6, A-7	0-3	95-100	90-100	75-95	50-85	30-45	10-20
	15-60	Loam, clay loam	ML, CL	A-6	0-3	95-100	90-100	70-95	50-80	30-40	10-20
Langhei---------	0-6	Loam-------------	CL-ML, CL	A-4, A-6	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	6-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
	19-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
979D2:											
Langhei---------	0-5	Loam-------------	CL-ML, CL	A-4, A-6	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	5-28	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
	28-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
Waukon----------	0-6	Loam-------------	ML, CL, CL-ML	A-6, A-4	0-3	95-100	90-100	80-95	60-90	20-40	5-20
	6-14	Clay loam, loam	CL, ML	A-6, A-7	0-3	95-100	90-100	75-95	50-85	30-45	10-20
	14-60	Loam, clay loam	ML, CL	A-6	0-3	95-100	90-100	70-95	50-80	30-40	10-20
1030. Pits- Udipsamments											
1113:											
Haslie----------	0-30	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	30-60	Coprogenous earth	OL	A-5	0	100	95-100	85-100	75-96	41-50	2-10
Seelyeville-----	0-22	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	22-60	Mucky-peat, muck	PT	A-8	0	---	---	---	---	---	---
Cathro----------	0-37	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	37-60	Sandy loam, silt loam, clay loam.	SC-SM, CL-ML, SC, CL	A-4, A-6	0-5	80-100	65-100	60-100	35-90	20-40	4-20
1117------------- Hedman	0-12	Loam-------------	ML, CL, CL-ML	A-4, A-6	0-4	95-100	85-98	55-40	50-70	20-35	5-15
	12-21	Fine sandy loam, loam, sandy loam.	SM, ML, CL-ML, SC-SM	A-4, A-2	0-4	95-100	85-98	50-85	35-60	15-30	5-15
	21-60	Loam, fine sandy loam, sandy loam.	SM, ML, CL-ML, SC-SM	A-4, A-2	0-4	95-100	85-98	50-85	35-60	15-30	5-12

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1139--------------	0-8	Loam-------------	CL	A-6	0-1	95-100	95-100	85-95	55-80	30-40	10-20
Marysland	8-16	Loam, clay loam	CL	A-6	0-1	95-100	95-100	85-95	55-80	35-45	15-25
	16-33	Loam, clay loam	CL	A-6	0-1	95-100	95-100	85-95	55-80	35-45	15-25
	33-60	Stratified loamy fine sand to gravelly coarse sand.	SM, SP-SM	A-1, A-2	0-5	75-95	70-95	40-70	15-30	---	NP
1142:											
Hedman-----------	0-13	Loam-------------	ML, CL, CL-ML	A-4, A-6	0-4	95-100	85-98	55-40	50-70	20-35	5-15
	13-21	Fine sandy loam, loam, sandy loam.	SM, ML, CL-ML, SC-SM	A-4, A-2	0-4	95-100	85-98	50-85	35-60	15-30	5-15
	21-60	Loam, fine sandy loam, sandy loam.	SM, ML, CL-ML, SC-SM	A-4, A-2	0-4	95-100	85-98	50-85	35-60	15-30	5-12
Fram-------------	0-19	Loam-------------	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	19-60	Sandy loam, fine sandy loam, loam.	SM, ML	A-4	0-1	95-100	90-100	60-100	35-90	20-40	NP-10
1147:											
Fordum-----------	0-9	Silt loam--------	ML, CL, SM, SC	A-4, A-6, A-2	0-15	35-100	25-100	20-100	15-90	20-35	3-15
	9-25	Silt loam, fine sandy loam, gravelly loam.	SM, SC, ML, CL	A-2, A-4, A-1	0-15	35-100	25-100	20-100	10-90	<30	3-10
	25-60	Sand, loamy fine sand, gravelly fine sand.	SP, SM, GP, SM	A-3, A-2, A-1	0-15	35-100	25-100	7-95	1-50	---	NP
Fairdale---------	0-8	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	3-15
	8-60	Stratified very fine sandy loam to silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	55-90	20-40	NP-20
Lamoure----------	0-25	Silty clay loam	CL, CH, MH, ML	A-7	0	100	100	95-100	85-100	40-70	15-35
	25-38	Silty clay loam, silt loam.	CL, CH, MH, ML	A-7	0	100	100	90-100	60-100	40-70	15-35
	38-60	Silty clay loam, silt loam, loam.	CL, ML	A-6, A-7	0	95-100	95-100	90-100	60-100	30-70	10-35
1148:											
Fairdale---------	0-14	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	3-15
	14-60	Stratified very fine sandy loam to silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	55-90	20-40	NP-20
Lamoure----------	0-31	Silty clay loam	CL, CH, MH, ML	A-7	0	100	100	95-100	85-100	40-70	15-35
	31-44	Silty clay loam, silt loam, loam.	CL, ML	A-6, A-7	0	95-100	95-100	90-100	60-100	30-70	10-35
	44-60	Stratified sandy loam to silty clay loam.	CL, SC	A-6, A-7	0	95-100	95-100	70-95	35-90	30-70	10-35

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1149------------- Hamerly	0-9	Clay loam--------	CL	A-6, A-7	0-5	95-100	90-100	80-95	75-95	30-45	10-25
	9-23	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	23-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	75-95	55-75	20-45	5-25
1152B------------ Sugarbush	0-4	Loamy sand-------	SM	A-2-4, A-1-b	0	95-100	90-100	45-70	15-30	---	NP
	4-7	Loamy sand, loamy coarse sand.	SM, SP-SM	A-1-b, A-2-4	0	95-100	90-100	40-70	10-25	---	NP
	7-22	Sandy loam, coarse sandy loam.	SM	A-2-4	0	95-100	90-100	50-70	25-35	<20	NP-4
	22-60	Gravelly coarse sand, gravelly sand.	SP, SP-SM	A-1-b, A-2-4, A-3	0-5	55-85	50-75	30-55	2-10	---	NP
1152C------------ Sugarbush	0-5	Loamy sand-------	SM	A-2-4, A-1-b	0	95-100	90-100	45-70	15-30	---	NP
	5-8	Loamy sand, loamy coarse sand.	SM, SP-SM	A-1-b, A-2-4	0	95-100	90-100	40-70	10-25	---	NP
	8-16	Sandy loam, coarse sandy loam.	SM	A-2-4	0	95-100	90-100	50-70	25-35	<20	NP-4
	16-60	Gravelly coarse sand, gravelly sand.	SP, SP-SM	A-1-b, A-2-4, A-3	0-5	55-85	50-75	30-55	2-10	---	NP
1152E------------ Sugarbush	0-3	Loamy sand-------	SM	A-2-4, A-1-b	0	95-100	90-100	45-70	15-30	---	NP
	3-13	Loamy sand, loamy coarse sand.	SM, SP-SM	A-1-b, A-2-4	0	95-100	90-100	40-70	10-25	---	NP
	13-25	Sandy loam, coarse sandy loam.	SM	A-2-4	0	95-100	90-100	50-70	25-35	<20	NP-4
	25-60	Gravelly coarse sand, gravelly sand.	SP, SP-SM	A-1-b, A-2-4, A-3	0-5	55-85	50-75	30-55	2-10	---	NP
1200------------- Egglake	0-4	Loam-------------	CL	A-4	0-5	93-99	87-97	50-97	50-90	15-25	3-7
	4-10	Fine sandy loam, sandy loam.	SM, SC-SM	A-2-4	0-5	93-99	87-97	40-50	25-35	15-21	2-4
	10-28	Sandy clay loam, sandy loam, loam.	SC, CL	A-6, A-4	0-5	93-99	87-97	55-75	40-60	28-36	9-15
	28-60	Sandy loam, coarse sandy loam.	SC-SM, SC, CL-ML, CL	A-4	0-5	93-99	87-97	50-70	35-55	21-28	4-9
1233D2:											
Esmond----------	0-5	Loam-------------	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	5-60	Loam, sandy loam, fine sandy loam.	ML, SM, SC, CL	A-4, A-6	0-5	90-100	85-100	60-100	35-90	20-40	NP-15

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1233D2:											
Heimdal	0-5	Loam	ML, CL, CL-ML	A-4, A-6	0-1	95-100	85-95	55-85	50-70	20-35	3-15
	5-11	Loam, fine sandy loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	95-100	85-95	50-80	35-65	15-30	3-15
	11-28	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-1	95-100	85-95	50-80	35-65	15-30	2-12
	28-60	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4, A-6	0-3	95-100	85-95	50-80	35-65	15-30	2-12
1238E:											
Two Inlets	0-2	Coarse sandy loam	SM, SP-SM	A-1, A-2, A-3, A-4	0-2	80-98	65-95	60-80	15-30	---	NP-4
	2-11	Loamy coarse sand, gravelly loamy coarse sand.	SP-SM	A-1, A-3	0-2	80-98	65-95	60-80	15-30	---	NP-4
	11-29	Loamy coarse sand, gravelly loamy coarse sand.	SP-SM	A-1, A-3	0-5	80-98	65-95	60-80	15-30	<25	NP-7
	29-60	Gravelly coarse sand.	SP, SP-SM	A-1, A-3	0-5	70-93	50-85	30-55	2-10	---	NP
Sugarbush	0-2	Coarse sandy loam	SM	A-2-4	0	95-100	90-100	55-70	25-35	<20	NP-4
	2-9	Loamy sand, loamy coarse sand.	SM, SP-SM	A-1-b, A-2-4	0	95-100	90-100	40-70	10-25	---	NP
	9-28	Sandy loam, coarse sandy loam.	SM	A-2-4	0	95-100	90-100	50-70	25-35	<20	NP-4
	28-60	Gravelly coarse sand, gravelly sand.	SP, SP-SM	A-1-b, A-2-4, A-3	0-5	55-85	50-75	30-55	2-10	---	NP
1241B Sandberg	0-10	Sandy loam	SM	A-2	0-5	85-100	80-95	50-65	25-35	<20	NP-7
	10-16	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-5	75-95	60-95	35-70	5-25	---	NP-4
	16-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-5	60-95	50-95	30-65	2-10	---	NP
1804 Hamre	0-13	Muck	PT	A-8	0	---	---	---	---	---	---
	13-19	Loam, clay loam, silt loam.	CL, CL-ML	A-4, A-6, A-7	0-3	90-100	80-100	70-100	50-90	25-45	6-20
	19-60	Loam, clay loam, silt loam.	CL, CL-ML	A-4, A-6, A-7	0-3	80-100	75-100	65-95	50-85	25-45	6-20
1825B Seelyeville	0-60	Muck	PT	A-8	0	---	---	---	---	---	---
1878 Hamre	0-14	Muck	PT	A-8	0	---	---	---	---	---	---
	14-19	Loam, clay loam, silt loam.	CL, CL-ML	A-4, A-6, A-7	0-3	90-100	80-100	70-100	50-90	25-45	6-20
	19-60	Loam, clay loam, silt loam.	CL, CL-ML	A-4, A-6, A-7	0-3	80-100	75-100	65-95	50-85	25-45	6-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1967:											
Hamerly----------	0-9	Clay loam--------	CL	A-6, A-7	0-5	95-100	90-100	80-95	75-95	30-45	10-25
	9-13	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	13-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Vallers----------	0-7	Silty clay loam	OL, CL, ML	A-6, A-7	0	95-100	95-100	95-100	85-95	30-50	11-20
	7-20	Clay loam, silty clay loam.	CL	A-6	0	95-100	90-100	80-95	50-80	30-40	11-20
	20-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	95-100	90-100	85-95	60-85	20-40	5-20

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
33B---------------	0-9	18-27	1.40-1.50	0.6-2.0	0.18-0.24	6.1-7.8	Low-----------	0.28	5	6	2-5
Barnes	9-15	18-27	1.50-1.60	0.6-2.0	0.15-0.19	6.1-7.8	Low-----------	0.28			
	15-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low-----------	0.37			
36----------------	0-10	27-35	1.25-1.45	0.2-0.6	0.18-0.22	6.1-7.8	Moderate-----	0.28	5	7	5-8
Flom	10-20	24-35	1.45-1.60	0.2-0.6	0.15-0.19	6.6-8.4	Moderate-----	0.28			
	20-60	24-35	1.55-1.65	0.2-0.6	0.14-0.19	7.4-8.4	Moderate-----	0.28			
38B---------------	0-7	12-27	1.40-1.60	0.6-2.0	0.20-0.24	6.1-7.3	Moderate-----	0.24	5	6	2-6
Waukon	7-24	18-35	1.40-1.60	0.6-2.0	0.15-0.19	6.1-8.4	Moderate-----	0.32			
	24-60	18-30	1.45-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low-----------	0.32			
38C---------------	0-8	12-27	1.40-1.60	0.6-2.0	0.20-0.24	6.1-7.3	Moderate-----	0.24	5	6	2-6
Waukon	8-23	18-35	1.40-1.60	0.6-2.0	0.15-0.19	6.1-8.4	Moderate-----	0.32			
	23-60	18-30	1.45-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low-----------	0.32			
38E---------------	0-4	12-27	1.40-1.60	0.6-2.0	0.20-0.24	6.1-7.3	Moderate-----	0.24	5	6	2-6
Waukon	4-20	18-35	1.40-1.60	0.6-2.0	0.15-0.19	6.1-8.4	Moderate-----	0.32			
	20-60	18-30	1.45-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low-----------	0.32			
40B---------------	0-5	5-20	1.30-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.32	5	5	1-2
Nebish	5-24	22-35	1.50-1.65	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	24-60	18-30	1.50-1.70	0.6-2.0	0.11-0.19	7.4-8.4	Low-----------	0.32			
40C---------------	0-3	5-20	1.30-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.32	5	5	1-2
Nebish	3-23	22-35	1.50-1.65	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	23-60	18-30	1.50-1.70	0.6-2.0	0.11-0.19	7.4-8.4	Low-----------	0.32			
40E---------------	0-2	5-20	1.30-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.32	5	5	1-2
Nebish	2-22	22-35	1.50-1.65	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	22-60	18-30	1.50-1.70	0.6-2.0	0.11-0.19	7.4-8.4	Low-----------	0.32			
59----------------	0-8	10-18	1.30-1.45	2.0-6.0	0.13-0.18	7.4-8.4	Low-----------	0.20	5	3	2-4
Grimstad	8-39	2-15	1.45-1.60	6.0-20	0.08-0.14	7.4-9.0	Low-----------	0.20			
	39-60	10-30	1.50-1.65	0.6-2.0	0.11-0.19	7.4-9.0	Low-----------	0.37			
63----------------	0-9	20-30	1.20-1.45	0.6-2.0	0.18-0.22	7.4-8.4	Low-----------	0.24	3	4L	4-8
Rockwell	9-27	5-30	1.35-1.50	2.0-6.0	0.15-0.17	7.9-8.4	Low-----------	0.24			
	27-34	3-10	1.40-1.60	6.0-20	0.05-0.07	7.4-7.8	Low-----------	0.24			
	34-60	15-30	1.40-1.60	0.2-2.0	0.18-0.22	7.4-7.8	Low-----------	0.24			
121---------------	0-6	5-18	1.30-1.55	0.6-6.0	0.13-0.18	5.1-6.5	Low-----------	0.20	5	3	2-6
Wykeham	6-10	5-15	1.50-1.70	0.6-2.0	0.10-0.17	5.1-6.5	Low-----------	0.28			
	10-30	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	30-60	10-18	1.55-1.75	0.6-2.0	0.11-0.16	7.4-8.4	Low-----------	0.28			
125---------------	0-4	6-18	1.30-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.32	5	5	3-6
Beltrami	4-9	5-15	1.40-1.65	0.6-6.0	0.11-0.19	5.6-7.3	Low-----------	0.32			
	9-36	18-35	1.50-1.65	0.2-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	36-60	18-30	1.50-1.70	0.6-2.0	0.15-0.19	7.4-8.4	Low-----------	0.32			
127B--------------	0-10	10-18	1.35-1.50	2.0-6.0	0.13-0.15	6.1-7.3	Low-----------	0.20	4	3	2-4
Sverdrup	10-27	6-18	1.40-1.55	2.0-6.0	0.08-0.14	6.1-7.8	Low-----------	0.20			
	27-60	0-10	1.50-1.65	6.0-20	0.02-0.06	7.4-8.4	Low-----------	0.15			
180---------------	0-10	10-27	1.30-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.24	5	6	2-5
Gonvick	10-25	22-35	1.35-1.50	0.2-2.0	0.15-0.19	6.6-7.3	Moderate-----	0.32			
	25-60	18-35	1.40-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low-----------	0.32			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi-bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
191-------------- Epoufette	0-9	5-15	1.35-1.50	2.0-6.0	0.09-0.14	6.1-7.3	Low----------	0.20	4	3	4-6
	9-27	5-15	1.40-1.55	6.0-20	0.05-0.07	6.1-7.3	Low----------	0.17			
	27-35	8-18	1.40-1.60	2.0-6.0	0.08-0.14	6.6-7.8	Low----------	0.17			
	35-60	0-8	1.40-1.65	>20	0.01-0.03	7.4-8.4	Low----------	0.10			
205-------------- Karlstad	0-11	5-15	1.20-1.45	2.0-6.0	0.13-0.18	4.5-7.3	Low----------	0.24	3	3	1-4
	11-20	5-18	1.35-1.60	2.0-6.0	0.13-0.18	6.1-7.3	Low----------	0.24			
	20-25	5-18	1.50-1.70	2.0-6.0	0.12-0.16	6.1-7.8	Low----------	0.10			
	25-60	1-5	1.50-1.70	>6.0	0.02-0.04	7.4-8.4	Low----------	0.10			
236-------------- Vallers	0-9	28-35	1.20-1.35	0.2-0.6	0.18-0.22	7.4-8.4	Moderate-----	0.28	5	4L	5-8
	9-19	18-35	1.40-1.55	0.2-0.6	0.15-0.19	7.4-8.4	Moderate-----	0.28			
	19-60	18-35	1.50-1.70	0.2-0.6	0.17-0.19	7.4-8.4	Low----------	0.28			
267B------------- Snellman	0-3	5-18	1.35-1.60	0.6-6.0	0.13-0.18	5.1-6.5	Low----------	0.20	5	3	1-3
	3-12	5-15	1.50-1.70	0.6-2.0	0.09-0.14	5.1-6.5	Low----------	0.28			
	12-23	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	23-60	7-18	1.60-1.80	0.6-2.0	0.11-0.16	7.4-8.4	Low----------	0.28			
267C------------- Snellman	0-3	5-18	1.35-1.60	0.6-6.0	0.13-0.18	5.1-6.5	Low----------	0.20	5	3	1-3
	3-19	5-15	1.50-1.70	0.6-2.0	0.09-0.14	5.1-6.5	Low----------	0.28			
	19-28	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	28-60	7-18	1.60-1.80	0.6-2.0	0.11-0.16	7.4-8.4	Low----------	0.28			
267E------------- Snellman	0-3	5-18	1.35-1.60	0.6-6.0	0.13-0.18	5.1-6.5	Low----------	0.20	5	3	1-3
	3-8	5-15	1.50-1.70	0.6-2.0	0.09-0.14	5.1-6.5	Low----------	0.28			
	8-29	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	29-60	7-18	1.60-1.80	0.6-2.0	0.11-0.16	7.4-8.4	Low----------	0.28			
290B------------- Rothsay	0-13	10-18	1.20-1.40	0.6-2.0	0.22-0.24	6.6-7.3	Low----------	0.32	5	5	3-6
	13-23	10-18	1.20-1.40	0.6-2.0	0.17-0.22	6.6-7.8	Low----------	0.43			
	23-60	10-18	1.20-1.40	0.6-6.0	0.20-0.22	7.4-8.4	Low----------	0.43			
296-------------- Fram	0-12	10-18	1.30-1.60	0.6-2.0	0.20-0.24	7.4-8.4	Low----------	0.28	5	4L	4-9
	12-60	7-18	1.40-1.60	0.6-2.0	0.13-0.20	7.4-8.4	Low----------	0.37			
332B------------- Sugarbush	0-3	5-15	1.30-1.50	2.0-6.0	0.13-0.15	5.6-7.3	Low----------	0.20	4	3	1-2
	3-9	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low----------	0.17			
	9-24	10-18	1.40-1.60	2.0-6.0	0.12-0.15	5.6-7.3	Low----------	0.24			
	24-60	1-5	1.60-1.80	>20	0.02-0.06	7.4-8.4	Low----------	0.10			
335-------------- Urness	0-12	18-27	0.25-0.50	0.2-2.0	0.18-0.24	7.4-8.4	Moderate-----	0.28	5	4L	10-50
	12-60	18-35	0.30-1.00	0.2-2.0	0.16-0.22	7.4-8.4	Moderate-----	0.28			
344-------------- Quam	0-9	28-35	1.00-1.35	0.2-0.6	0.18-0.22	6.6-7.8	Moderate-----	0.28	5	7	6-15
	9-44	22-35	1.25-1.45	0.2-0.6	0.16-0.22	6.6-7.8	Moderate-----	0.28			
	44-60	20-35	1.40-1.65	0.2-0.6	0.14-0.19	7.4-8.4	Moderate-----	0.37			
346-------------- Talmoon	0-5	8-20	1.10-1.35	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.28	5	5	2-4
	5-13	15-27	1.20-1.40	0.6-2.0	0.13-0.22	5.1-7.3	Low----------	0.37			
	13-25	22-35	1.40-1.60	0.2-0.6	0.16-0.19	5.6-7.3	Moderate-----	0.37			
	25-60	18-30	1.40-1.60	0.2-0.6	0.15-0.19	7.4-8.4	Moderate-----	0.37			
352B------------- Heimdal	0-8	10-20	1.30-1.60	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.24	5	5	3-6
	8-17	10-18	1.35-1.65	0.6-2.0	0.12-0.19	6.1-7.8	Low----------	0.28			
	17-32	10-18	1.45-1.65	0.6-2.0	0.11-0.19	7.4-8.4	Low----------	0.28			
	32-60	7-18	1.65-1.80	0.6-2.0	0.11-0.16	7.4-8.4	Low----------	0.28			
426-------------- Foldahl	0-8	4-15	1.30-1.50	2.0-6.0	0.14-0.18	6.1-7.8	Low----------	0.20	5	3	2-5
	8-30	2-10	1.45-1.60	6.0-20	0.07-0.12	6.6-7.8	Low----------	0.20			
	30-60	18-35	1.50-1.65	0.2-2.0	0.14-0.19	7.4-8.4	Moderate-----	0.37			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
494B	0-28	18-27	1.25-1.40	0.6-2.0	0.20-0.24	6.6-7.8	Low	0.28	5	6	4-8
Darnen	28-38	18-30	1.40-1.60	0.6-2.0	0.15-0.19	6.1-7.8	Moderate	0.28			
	38-60	18-30	1.55-1.65	0.6-2.0	0.14-0.19	7.4-8.4	Moderate	0.37			
540	0-44	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-------------	----	5	2	>25
Seelyeville	44-60	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-------------	----			
543	0-28	---	0.15-0.45	0.2-6.0	0.35-0.45	4.5-7.8	-------------	----	4	2	55-85
Markey	28-60	0-10	1.40-1.65	6.0-20	0.03-0.08	5.6-8.4	Low	----			
544	0-15	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	-------------	----	5	2	60-85
Cathro	15-24	---	0.15-0.30	0.2-6.0	0.35-0.45	4.5-7.8	-------------	----			
	24-60	10-30	1.50-1.70	0.2-2.0	0.11-0.22	6.6-8.4	Low	----			
718B	0-4	22-27	1.30-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Moderate	0.28	5	6	3-6
Naytahwaush	4-8	12-26	1.30-1.50	0.2-2.0	0.16-0.24	5.6-7.3	Moderate	0.28			
	8-32	35-60	1.25-1.40	0.06-0.2	0.10-0.19	6.1-7.8	High	0.28			
	32-60	22-35	1.30-1.55	0.2-0.6	0.14-0.19	7.4-8.4	Moderate	0.28			
718C	0-5	22-27	1.30-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Moderate	0.28	5	6	3-6
Naytahwaush	5-8	12-26	1.30-1.50	0.2-2.0	0.16-0.24	5.6-7.3	Moderate	0.28			
	8-22	35-60	1.25-1.40	0.06-0.2	0.10-0.19	6.1-7.8	High	0.28			
	22-60	22-35	1.30-1.55	0.2-0.6	0.14-0.19	7.4-8.4	Moderate	0.28			
718E	0-3	22-27	1.30-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Moderate	0.28	5	6	3-6
Naytahwaush	3-6	12-26	1.30-1.50	0.2-2.0	0.16-0.24	5.6-7.3	Moderate	0.28			
	6-20	35-60	1.25-1.40	0.06-0.2	0.10-0.19	6.1-7.8	High	0.28			
	20-60	22-35	1.30-1.55	0.2-0.6	0.14-0.19	7.4-8.4	Moderate	0.28			
737	0-4	22-35	1.30-1.55	0.2-0.6	0.17-0.22	5.6-7.3	Moderate	0.32	5	6	3-6
Mahkonce	4-10	16-26	1.30-1.55	0.2-0.6	0.16-0.22	5.6-7.3	Moderate	0.32			
	10-26	45-60	1.25-1.40	0.06-0.2	0.13-0.19	6.1-7.3	High	0.24			
	26-60	25-35	1.30-1.55	0.2-0.6	0.13-0.19	7.4-8.4	Moderate	0.32			
746	0-42	---	0.10-0.30	0.6-6.0	0.35-0.48	5.6-7.8	-------------	----	5	2	60-90
Haslie	42-60	18-35	0.10-0.50	0.06-0.2	0.18-0.24	6.6-8.4	Moderate	0.28			
748	0-12	18-26	1.10-1.30	0.6-2.0	0.20-0.22	6.6-7.3	Low	0.32	5	6	4-8
Hamlet	12-20	18-35	1.20-1.50	0.6-2.0	0.15-0.19	6.6-7.8	Moderate	0.32			
	20-60	18-35	1.20-1.50	0.06-2.0	0.14-0.19	7.9-8.4	Moderate	0.32			
749	0-9	20-32	1.20-1.50	0.6-2.0	0.20-0.22	7.4-8.4	Moderate	0.32	5	4L	4-8
Colvin	9-28	18-32	1.20-1.50	0.2-2.0	0.18-0.21	7.4-8.4	Moderate	0.37			
	28-52	18-32	1.20-1.50	0.2-2.0	0.17-0.20	7.4-8.4	Moderate	0.37			
	52-60	15-35	1.30-1.50	0.2-2.0	0.17-0.20	7.4-8.4	Moderate	0.32			
767	0-5	12-27	1.35-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.32	3	6	3-8
Auganaush	5-8	5-18	1.40-1.60	0.6-2.0	0.16-0.24	5.6-7.3	Low	0.24			
	8-22	35-60	1.25-1.50	0.06-0.2	0.10-0.19	5.6-7.3	High	0.28			
	22-60	27-45	1.30-1.55	0.06-0.6	0.14-0.19	7.4-8.4	Moderate	0.32			
775B:											
Sugarbush	0-4	5-15	1.30-1.50	2.0-6.0	0.13-0.15	5.6-7.3	Low	0.20	4	3	1-2
	4-9	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low	0.17			
	9-27	10-18	1.40-1.60	2.0-6.0	0.12-0.15	5.6-7.3	Low	0.24			
	27-60	1-5	1.60-1.80	>20	0.02-0.06	7.4-8.4	Low	0.10			
Two Inlets	0-2	2-10	1.40-1.60	6.0-20	0.10-0.15	5.6-7.3	Low	0.15	5	2	1-2
	2-8	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low	0.15			
	8-27	5-15	1.40-1.60	6.0-20	0.09-0.11	6.1-7.3	Low	0.15			
	27-60	0-3	1.60-1.80	>20	0.02-0.04	7.4-8.4	Low	0.10			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi-bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
775C:											
Sugarbush-------	0-3	5-15	1.30-1.50	2.0-6.0	0.13-0.15	5.6-7.3	Low-----------	0.20	4	3	1-2
	3-10	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low-----------	0.17			
	10-27	10-18	1.40-1.60	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.24			
	27-60	1-5	1.60-1.80	>20	0.02-0.06	7.4-8.4	Low-----------	0.10			
Two Inlets------	0-3	2-10	1.40-1.60	6.0-20	0.10-0.15	5.6-7.3	Low-----------	0.15	5	2	1-2
	3-9	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low-----------	0.15			
	9-29	5-15	1.40-1.60	6.0-20	0.09-0.11	6.1-7.3	Low-----------	0.15			
	29-60	0-3	1.60-1.80	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
776B:											
Snellman--------	0-2	5-18	1.35-1.60	0.6-6.0	0.13-0.18	5.1-6.5	Low-----------	0.20	5	3	1-3
	2-18	5-15	1.50-1.70	0.6-2.0	0.09-0.14	5.1-6.5	Low-----------	0.28			
	18-33	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	33-60	7-18	1.60-1.80	0.6-2.0	0.11-0.16	7.4-8.4	Low-----------	0.28			
Sugarbush-------	0-3	5-15	1.30-1.50	2.0-6.0	0.13-0.15	5.6-7.3	Low-----------	0.20	4	3	1-2
	3-13	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low-----------	0.17			
	13-35	10-18	1.40-1.60	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.24			
	35-60	1-5	1.60-1.80	>20	0.02-0.06	7.4-8.4	Low-----------	0.10			
776C:											
Snellman--------	0-2	5-18	1.35-1.60	0.6-6.0	0.13-0.18	5.1-6.5	Low-----------	0.20	5	3	1-3
	2-18	5-15	1.50-1.70	0.6-2.0	0.09-0.14	5.1-6.5	Low-----------	0.28			
	18-26	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	26-60	7-18	1.60-1.80	0.6-2.0	0.11-0.16	7.4-8.4	Low-----------	0.28			
Sugarbush-------	0-2	5-15	1.30-1.50	2.0-6.0	0.13-0.15	5.6-7.3	Low-----------	0.20	4	3	1-2
	2-12	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low-----------	0.17			
	12-25	10-18	1.40-1.60	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.24			
	25-60	1-5	1.60-1.80	>20	0.02-0.06	7.4-8.4	Low-----------	0.10			
776E:											
Snellman--------	0-2	5-18	1.35-1.60	0.6-6.0	0.13-0.18	5.1-6.5	Low-----------	0.20	5	3	1-3
	2-12	5-15	1.50-1.70	0.6-2.0	0.09-0.14	5.1-6.5	Low-----------	0.28			
	12-22	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	22-60	7-18	1.60-1.80	0.6-2.0	0.11-0.16	7.4-8.4	Low-----------	0.28			
Sugarbush-------	0-1	5-15	1.30-1.50	2.0-6.0	0.13-0.15	5.6-7.3	Low-----------	0.20	4	3	1-2
	1-9	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low-----------	0.17			
	9-22	10-18	1.40-1.60	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.24			
	22-60	1-5	1.60-1.80	>20	0.02-0.06	7.4-8.4	Low-----------	0.10			
827B:											
Heimdal---------	0-8	10-20	1.30-1.60	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.24	5	5	3-6
	8-17	10-18	1.35-1.65	0.6-2.0	0.12-0.19	6.1-7.8	Low-----------	0.28			
	17-30	10-18	1.45-1.65	0.6-2.0	0.11-0.19	7.4-8.4	Low-----------	0.28			
	30-60	7-18	1.65-2.00	0.2-0.6	0.04-0.15	7.4-8.4	Low-----------	0.28			
Esmond----------	0-7	10-18	1.30-1.60	0.6-2.0	0.20-0.22	7.4-8.4	Low-----------	0.28	5	4L	1-4
	7-60	7-18	1.40-1.60	0.6-2.0	0.14-0.22	7.4-8.4	Low-----------	0.37			
827C2:											
Heimdal---------	0-8	10-20	1.30-1.60	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.24	5	5	3-6
	8-15	10-18	1.35-1.65	0.6-2.0	0.12-0.19	6.1-7.8	Low-----------	0.28			
	15-26	10-18	1.45-1.65	0.6-2.0	0.11-0.19	7.4-8.4	Low-----------	0.28			
	26-60	7-18	1.65-2.00	0.2-0.6	0.04-0.15	7.4-8.4	Low-----------	0.28			
Esmond----------	0-8	10-18	1.30-1.60	0.6-2.0	0.20-0.22	7.4-8.4	Low-----------	0.28	5	4L	1-4
	8-60	7-18	1.40-1.60	0.6-2.0	0.14-0.22	7.4-8.4	Low-----------	0.37			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
867B:											
Graycalm---------	0-2	0-10	1.30-1.55	6.0-20	0.06-0.12	4.5-6.5	Low----------	0.17	5	2	.5-2
	2-18	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low----------	0.15			
	18-60	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low----------	0.15			
Menahga----------	0-8	2-10	1.20-1.50	6.0-20	0.10-0.12	4.5-6.5	Low----------	0.15	5	2	.5-2
	8-22	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low----------	0.15			
	22-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.3	Low----------	0.15			
903B:											
Barnes-----------	0-7	18-27	1.40-1.50	0.6-2.0	0.18-0.24	6.1-7.8	Low----------	0.28	5	6	2-5
	7-14	18-27	1.50-1.60	0.6-2.0	0.15-0.19	6.1-7.8	Low----------	0.28			
	14-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.37			
Langhei----------	0-5	18-27	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Low----------	0.32	5	4L	.5-3
	5-19	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.9-8.4	Low----------	0.32			
	19-60	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low----------	0.32			
903C2:											
Barnes-----------	0-6	18-27	1.40-1.50	0.6-2.0	0.18-0.24	6.1-7.8	Low----------	0.28	5	6	2-5
	6-11	18-27	1.50-1.60	0.6-2.0	0.15-0.19	6.1-7.8	Low----------	0.28			
	11-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.37			
Langhei----------	0-4	18-27	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Low----------	0.32	5	4L	.5-3
	4-32	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.9-8.4	Low----------	0.32			
	32-60	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low----------	0.32			
942D2:											
Langhei----------	0-6	18-27	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Low----------	0.32	5	4L	.5-3
	6-26	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.9-8.4	Low----------	0.32			
	26-60	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low----------	0.32			
Barnes-----------	0-7	18-27	1.40-1.50	0.6-2.0	0.18-0.24	6.1-7.8	Low----------	0.28	5	6	2-5
	7-13	18-27	1.50-1.60	0.6-2.0	0.15-0.19	6.1-7.8	Low----------	0.28			
	13-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.37			
967B:											
Waukon-----------	0-6	12-27	1.40-1.60	0.6-2.0	0.20-0.24	6.1-7.3	Moderate-----	0.24	5	6	2-6
	6-20	18-35	1.40-1.60	0.6-2.0	0.15-0.19	6.1-8.4	Moderate-----	0.32			
	20-60	18-30	1.45-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low----------	0.32			
Langhei----------	0-6	18-27	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Low----------	0.32	5	4L	.5-3
	6-39	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.9-8.4	Low----------	0.32			
	39-60	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low----------	0.32			
967C2:											
Waukon-----------	0-6	12-27	1.40-1.60	0.6-2.0	0.20-0.24	6.1-7.3	Moderate-----	0.24	5	6	2-6
	6-15	18-35	1.40-1.60	0.6-2.0	0.15-0.19	6.1-8.4	Moderate-----	0.32			
	15-60	18-30	1.45-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low----------	0.32			
Langhei----------	0-6	18-27	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Low----------	0.32	5	4L	.5-3
	6-19	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.9-8.4	Low----------	0.32			
	19-60	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low----------	0.32			
979D2:											
Langhei----------	0-5	18-27	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Low----------	0.32	5	4L	.5-3
	5-28	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.9-8.4	Low----------	0.32			
	28-60	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low----------	0.32			
Waukon-----------	0-6	12-27	1.40-1.60	0.6-2.0	0.20-0.24	6.1-7.3	Moderate-----	0.24	5	6	2-6
	6-14	18-35	1.40-1.60	0.6-2.0	0.15-0.19	6.1-8.4	Moderate-----	0.32			
	14-60	18-30	1.45-1.65	0.6-2.0	0.15-0.19	7.4-8.4	Low----------	0.32			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
1030. Pits- Udipsamments											
1113:											
Haslie----------	0-30	---	0.10-0.30	0.6-6.0	0.35-0.48	5.6-7.8	-------------	----	5	8	60-90
	30-60	18-35	0.10-0.50	0.06-0.2	0.18-0.24	6.6-8.4	Moderate-----	0.28			
Seelyeville-----	0-22	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-------------	----	5	8	>25
	22-60	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-------------	----			
Cathro----------	0-37	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	-------------	----	5	8	60-85
	37-60	10-30	1.50-1.70	0.2-2.0	0.11-0.22	5.6-8.4	Low----------	----			
1117------------- Hedman	0-12	12-18	1.30-1.50	0.6-2.0	0.20-0.22	6.6-7.8	Low----------	0.24	5	4L	4-8
	12-21	10-18	1.35-1.65	0.6-2.0	0.12-0.19	7.4-8.4	Low----------	0.28			
	21-60	10-18	1.45-1.65	0.6-2.0	0.11-0.19	7.4-8.4	Low----------	0.28			
1139------------- Marysland	0-8	18-27	1.20-1.35	0.6-2.0	0.17-0.22	7.4-8.4	Moderate-----	0.28	4	4L	4-8
	8-16	20-30	1.20-1.35	0.6-2.0	0.16-0.21	7.9-8.4	Moderate-----	0.32			
	16-33	22-30	1.25-1.40	0.6-2.0	0.16-0.21	7.4-8.4	Moderate-----	0.32			
	33-60	1-5	1.30-1.50	6.0-20	0.03-0.08	7.4-8.4	Low----------	0.15			
1142:											
Hedman----------	0-13	12-18	1.30-1.50	0.6-2.0	0.20-0.22	6.6-7.8	Low----------	0.24	5	4L	4-8
	13-21	10-18	1.35-1.65	0.6-2.0	0.12-0.19	7.4-8.4	Low----------	0.28			
	21-60	10-18	1.45-1.65	0.6-2.0	0.11-0.19	7.4-8.4	Low----------	0.28			
Fram------------	0-19	10-18	1.30-1.60	0.6-2.0	0.20-0.24	7.4-8.4	Low----------	0.28	5	4L	4-9
	19-60	7-18	1.40-1.60	0.6-2.0	0.13-0.20	7.4-8.4	Low----------	0.37			
1147:											
Fordum----------	0-9	10-23	1.35-1.45	0.6-2.0	0.17-0.24	5.6-8.4	Low----------	0.28	4	8	4-12
	9-25	8-18	1.40-1.50	0.6-6.0	0.10-0.22	5.6-8.4	Low----------	0.43			
	25-60	2-5	1.55-1.70	>6.0	0.04-0.10	5.6-8.4	Low----------	0.15			
Fairdale--------	0-8	18-27	1.20-1.40	0.6-2.0	0.20-0.24	7.4-7.8	Low----------	0.32	5	4L	3-7
	8-60	18-35	1.20-1.50	0.6-2.0	0.17-0.23	7.4-8.4	Moderate-----	0.32			
Lamoure---------	0-25	27-34	1.15-1.25	0.2-2.0	0.19-0.22	7.4-8.4	Moderate-----	0.28	5	4L	4-8
	25-38	20-34	1.20-1.35	0.2-2.0	0.17-0.20	7.4-8.4	Moderate-----	0.28			
	38-60	20-34	1.20-1.35	0.2-2.0	0.17-0.20	7.4-8.4	Moderate-----	0.28			
1148:											
Fairdale--------	0-14	18-27	1.20-1.40	0.6-2.0	0.20-0.24	7.4-7.8	Low----------	0.32	5	4L	3-7
	14-60	18-35	1.20-1.50	0.6-2.0	0.17-0.23	7.4-8.4	Moderate-----	0.32			
Lamoure---------	0-31	27-34	1.15-1.25	0.2-2.0	0.19-0.22	7.4-8.4	Moderate-----	0.28	5	4L	4-8
	31-44	20-34	1.20-1.35	0.2-2.0	0.17-0.20	7.4-8.4	Moderate-----	0.28			
	44-60	20-34	1.25-1.40	0.2-2.0	0.09-0.18	7.4-8.4	Moderate-----	0.28			
1149------------- Hamerly	0-9	27-35	1.20-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Moderate-----	0.28	5	4L	4-7
	9-23	18-35	1.20-1.60	0.6-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.28			
	23-60	18-35	1.30-1.60	0.2-0.6	0.14-0.19	7.4-8.4	Moderate-----	0.37			
1152B------------ Sugarbush	0-4	3-10	1.35-1.55	6.0-20	0.10-0.12	5.6-7.3	Low----------	0.17	4	2	.5-1
	4-7	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low----------	0.17			
	7-22	10-18	1.40-1.60	2.0-6.0	0.12-0.15	5.6-7.3	Low----------	0.24			
	22-60	1-5	1.60-1.80	>20	0.02-0.06	7.4-8.4	Low----------	0.10			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
1152C------------	0-5	3-10	1.35-1.55	6.0-20	0.10-0.12	5.6-7.3	Low-----------	0.17	4	2	.5-1
Sugarbush	5-8	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low-----------	0.17			
	8-16	10-18	1.40-1.60	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.24			
	16-60	1-5	1.60-1.80	>20	0.02-0.06	7.4-8.4	Low-----------	0.10			
1152E------------	0-3	3-10	1.35-1.55	6.0-20	0.10-0.12	5.6-7.3	Low-----------	0.17	4	2	.5-1
Sugarbush	3-13	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low-----------	0.17			
	13-25	10-18	1.40-1.60	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.24			
	25-60	1-5	1.60-1.80	>20	0.02-0.06	7.4-8.4	Low-----------	0.10			
1200-------------	0-4	8-15	1.35-1.60	0.6-6.0	0.10-0.21	5.6-7.3	Low-----------	0.28	5	5	2-4
Egglake	4-10	3-10	1.50-1.70	0.6-6.0	0.12-0.14	5.6-7.3	Low-----------	0.24			
	10-28	18-30	1.50-1.70	0.6-2.0	0.16-0.18	5.6-7.3	Moderate-----	0.32			
	28-60	10-18	1.60-1.80	0.6-2.0	0.11-0.13	7.4-8.4	Low-----------	0.24			
1233D2:											
Esmond----------	0-5	10-18	1.30-1.60	0.6-2.0	0.20-0.22	7.4-8.4	Low-----------	0.28	5	4L	1-4
	5-60	7-18	1.40-1.60	0.6-2.0	0.14-0.22	7.4-8.4	Low-----------	0.37			
Heimdal---------	0-5	10-20	1.30-1.60	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.24	5	5	3-6
	5-11	10-18	1.35-1.65	0.6-2.0	0.12-0.19	6.1-7.8	Low-----------	0.28			
	11-28	10-18	1.45-1.65	0.6-2.0	0.11-0.19	7.4-8.4	Low-----------	0.28			
	28-60	7-18	1.65-2.00	0.2-0.6	0.04-0.15	7.4-8.4	Low-----------	0.28			
1238E:											
Two Inlets------	0-2	2-10	1.40-1.60	6.0-20	0.10-0.15	5.6-7.3	Low-----------	0.15	5	2	1-2
	2-11	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low-----------	0.15			
	11-29	5-15	1.40-1.60	6.0-20	0.09-0.11	6.1-7.3	Low-----------	0.15			
	29-60	0-3	1.60-1.80	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
Sugarbush-------	0-2	5-15	1.30-1.50	2.0-6.0	0.13-0.15	5.6-7.3	Low-----------	0.20	4	3	1-2
	2-9	2-10	1.40-1.60	6.0-20	0.09-0.11	5.6-7.3	Low-----------	0.17			
	9-28	10-18	1.40-1.60	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.24			
	28-60	1-5	1.60-1.80	>20	0.02-0.06	7.4-8.4	Low-----------	0.10			
1241B------------	0-10	5-15	1.35-1.55	2.0-6.0	0.13-0.15	6.1-7.8	Low-----------	0.17	5	3	1-4
Sandberg	10-16	0-10	1.50-1.65	6.0-20	0.03-0.10	6.1-7.8	Low-----------	0.10			
	16-60	0-5	1.50-1.65	>20	0.02-0.06	7.4-8.4	Low-----------	0.10			
1804-------------	0-13	---	0.18-0.22	0.2-2.0	0.35-0.48	5.1-7.8	Low-----------	----	5	2	85-95
Hamre	13-19	18-35	1.30-1.70	0.2-2.0	0.17-0.19	5.6-7.8	Moderate-----	0.32			
	19-60	18-35	1.40-1.70	0.2-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.32			
1825B------------	0-60	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.8	-------------	0.10	5	8	>25
Seelyeville											
1878-------------	0-14	---	0.18-0.22	0.2-2.0	0.35-0.48	5.1-7.8	Low-----------	----	5	2	85-95
Hamre	14-19	18-35	1.30-1.70	0.2-2.0	0.17-0.19	5.6-7.8	Moderate-----	0.32			
	19-60	18-35	1.40-1.70	0.2-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.32			
1967:											
Hamerly---------	0-9	27-35	1.20-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Moderate-----	0.28	5	4L	4-7
	9-13	18-35	1.20-1.60	0.6-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.28			
	13-60	18-35	1.30-1.60	0.2-0.6	0.14-0.19	7.4-8.4	Moderate-----	0.37			
Vallers---------	0-7	28-35	1.20-1.35	0.2-0.6	0.18-0.22	7.4-8.4	Moderate-----	0.28	5	4L	5-8
	7-20	18-35	1.40-1.55	0.2-0.6	0.15-0.19	7.4-8.4	Moderate-----	0.28			
	20-60	18-35	1.50-1.70	0.2-0.6	0.17-0.19	7.4-8.4	Low-----------	0.28			

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "frequent," "brief," and "apparent" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Subsidence		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Initial	Total		Uncoated steel	Concrete
					Ft			In	In			
33B Barnes	B	None	---	---	>6.0	---	---	---	---	Moderate	Moderate	Low.
36 Flom	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jul	---	---	High	High	Low.
38B, 38C, 38E Waukon	B	None	---	---	>6.0	---	---	---	---	Moderate	Low	Low.
40B, 40C, 40E Nebish	B	None	---	---	>6.0	---	---	---	---	Moderate	Moderate	Low.
59 Grimstad	B	None	---	---	2.5-4.0	Apparent	Apr-Jul	---	---	Moderate	Moderate	Low.
63 Rockwell	B/D	None	---	---	1.0-3.0	Apparent	Apr-Jul	---	---	High	High	Low.
121 Wykeham	B	None	---	---	2.5-4.0	Apparent	Apr-Jun	---	---	Moderate	Moderate	Moderate.
125 Beltrami	B	None	---	---	2.0-4.0	Apparent	Nov-Jun	---	---	High	Moderate	Low.
127B Sverdrup	B	None	---	---	>6.0	---	---	---	---	Low	Low	Low.
180 Gonvick	B	None	---	---	2.5-4.0	Apparent	Nov-Jun	---	---	High	Moderate	Low.
191 Epoufette	B/D	None	---	---	0.5-2.0	Apparent	Nov-Jun	---	---	High	High	Moderate.
205 Karlstad	A	None	---	---	2.5-6.0	Apparent	Apr-Jul	---	---	Moderate	Low	Low.
236 Vallers	C	None	---	---	1.0-2.5	Apparent	Nov-Jun	---	---	High	High	Low.
267B, 267C, 267E Snellman	B	None	---	---	>6.0	---	---	---	---	Moderate	Low	Moderate.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Subsidence		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Ini-tial	Total		Uncoated steel	Concrete
					Ft			In	In			
290B-------------- Rothsay	B	None---------	---	---	>6.0	---	---	---	---	High-----	Low------	Low.
296--------------- Fram	B	None---------	---	---	2.0-6.0	Apparent	Sep-Jun	---	---	High-----	High-----	Low.
332B-------------- Sugarbush	B	None---------	---	---	>6.0	---	---	---	---	Low------	Low------	Low.
335--------------- Urness	B/D	None---------	---	---	+2-1.0	Apparent	Jan-Dec	---	---	High-----	High-----	Low.
344--------------- Quam	B/D	None---------	---	---	+2-1.0	Apparent	Jan-Dec	---	---	High-----	High-----	Low.
346--------------- Talmoon	C	None---------	---	---	1.0-3.0	Apparent	Nov-Jun	---	---	High-----	High-----	Moderate.
352B-------------- Heimdal	B	None---------	---	---	>6.0	---	---	---	---	Moderate	High-----	Low.
426--------------- Foldahl	B	None---------	---	---	2.5-4.0	Apparent	Nov-Jun	---	---	High-----	Moderate	Low.
494B-------------- Darnen	B	None---------	---	---	>6.0	---	---	---	---	Moderate	High-----	Low.
540--------------- Seelyeville	A/D	None---------	---	---	+2-2.0	Apparent	Oct-Jun	---	50-55	High-----	High-----	Moderate.
543--------------- Markey	A/D	None---------	---	---	+1-1.0	Apparent	Nov-Jun	---	25-30	High-----	High-----	Low.
544--------------- Cathro	A/D	None---------	---	---	+1-1.0	Apparent	Oct-Jun	---	19-22	High-----	High-----	Low.
718B, 718C, 718E- Naytahwaush	B	None---------	---	---	>6.0	---	---	---	---	High-----	Moderate	Low.
737--------------- Mahkonce	C	None---------	---	---	2.0-4.0	Apparent	Mar-May	---	---	High-----	High-----	Low.
746--------------- Haslie	A/D	None---------	---	---	+1-1.0	Apparent	Nov-Jul	---	0	High-----	High-----	Moderate.
748--------------- Hamlet	B	None---------	---	---	3.0-5.0	Apparent	Apr-Jun	---	---	High-----	High-----	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Subsidence		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Initial	Total		Uncoated steel	Concrete
					Ft			In	In			
749 Colvin	C/D	Occasional	Brief	Mar-Jun	0-1.0	Apparent	Mar-Jun	---	---	High	High	Low.
767 Auganaush	C	None	---	---	1.0-3.0	Apparent	Nov-Jun	---	---	High	High	Moderate.
775B, 775C:												
Sugarbush	B	None	---	---	>6.0	---	---	---	---	Low	Low	Low.
Two Inlets	A	None	---	---	>6.0	---	---	---	---	Low	Low	Low.
776B, 776C, 776E:												
Snellman	B	None	---	---	>6.0	---	---	---	---	Moderate	Low	Moderate.
Sugarbush	B	None	---	---	>6.0	---	---	---	---	Low	Low	Low.
827B, 827C2:												
Heimdal	B	None	---	---	>6.0	---	---	---	---	Moderate	High	Low.
Esmond	B	None	---	---	>6.0	---	---	---	---	Moderate	High	Low.
867B:												
Graycalm	A	None	---	---	>6.0	---	---	---	---	Low	Low	Moderate.
Menahga	A	None	---	---	>6.0	---	---	---	---	Low	Low	Moderate.
903B, 903C2:												
Barnes	B	None	---	---	>6.0	---	---	---	---	Moderate	Moderate	Low.
Langhei	B	None	---	---	>6.0	---	---	---	---	Moderate	Low	Low.
942D2:												
Langhei	B	None	---	---	>6.0	---	---	---	---	Moderate	Low	Low.
Barnes	B	None	---	---	>6.0	---	---	---	---	Moderate	Moderate	Low.
967B, 967C2:												
Waukon	B	None	---	---	>6.0	---	---	---	---	Moderate	Low	Low.
Langhei	B	None	---	---	>6.0	---	---	---	---	Moderate	Low	Low.
979D2:												
Langhei	B	None	---	---	>6.0	---	---	---	---	Moderate	Low	Low.
Waukon	B	None	---	---	>6.0	---	---	---	---	Moderate	Low	Low.
1030. Pits- Udipsamments												

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Subsidence		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Ini-tial	Total		Uncoated steel	Concrete
					Ft			In	In			
1113:												
Haslie----------	D	None--------	---	---	+1-1.0	Apparent	Jan-Dec	---	30-45	High-----	High-----	Moderate.
Seelyeville-----	D	None--------	---	---	+4-0.5	Apparent	Jan-Dec	---	---	High-----	---	---
Cathro----------	D	None--------	---	---	+4-0.5	Apparent	Jan-Dec	---	---	High-----	High-----	Low.
1117------------- Hedman	B/D	None--------	---	---	0-2.0	Apparent	Apr-Jul	---	---	High-----	High-----	Low.
1139------------- Marysland	B/D	Occasional	Brief-----	Mar-Jun	0.5-1.5	Apparent	Nov-Jun	---	---	High-----	High-----	Low.
1142:												
Hedman----------	B/D	None--------	---	---	0-2.0	Apparent	Apr-Jul	---	---	High-----	High-----	Low.
Fram------------	B	None--------	---	---	2.0-6.0	Apparent	Sep-Jun	---	---	High-----	High-----	Low.
1147:												
Fordum----------	D	Frequent----	Brief or long.	Mar-Jun	+1-1.0	Apparent	Jan-Dec	---	---	High-----	High-----	High.
Fairdale--------	B	Frequent----	Brief-----	Mar-Jun	3.5-6.0	---	Oct-Jun	---	---	Moderate	Moderate	Low.
Lamoure---------	C	Frequent----	Brief-----	Mar-Oct	0-2.0	Apparent	Oct-Jun	---	---	High-----	High-----	Moderate.
1148:												
Fairdale--------	B	Occasional	Brief-----	Mar-Jun	3.5-6.0	---	Oct-Jun	---	---	Moderate	Moderate	Low.
Lamoure---------	C	Occasional	Brief-----	Mar-Oct	0-2.0	Apparent	Oct-Jun	---	---	High-----	High-----	Moderate.
1149------------- Hamerly	C	None--------	---	---	2.0-4.0	Apparent	Apr-Jun	---	---	High-----	High-----	Low.
1152B, 1152C, 1152E----------- Sugarbush	B	None--------	---	---	>6.0	---	---	---	---	Low------	Low------	Low.
1200------------- Egglake	B	None--------	---	---	1.0-3.0	Apparent	Oct-Jul	---	---	High-----	High-----	Low.
1233D2:												
Esmond----------	B	None--------	---	---	>6.0	---	---	---	---	Moderate	High-----	Low.
Heimdal---------	B	None--------	---	---	>6.0	---	---	---	---	Moderate	High-----	Low.
1238E:												
Two Inlets------	A	None--------	---	---	>6.0	---	---	---	---	Low------	Low------	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Subsidence		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Ini-tial	Total		Uncoated steel	Concrete
					Ft			In	In			
1238E:												
Sugarbush--------	B	None---------	---	---	>6.0	---	---	---	---	Low-------	Low-------	Low.
1241B------------- Sandberg	A	None---------	---	---	>6.0	---	---	---	---	Low-------	Moderate	Low.
1804-------------- Hamre	C/D	None---------	---	---	+1-1.0	Apparent	Jan-Dec	---	---	High------	High------	Low.
1825B------------- Seelyeville	D	None---------	---	---	0-2.0	Apparent	Jan-Dec	4-12	50-55	High------	High------	Moderate.
1878-------------- Hamre	C/D	None---------	---	---	+1-1.0	Apparent	Jan-Dec	---	---	High------	High------	Low.
1967:												
Hamerly----------	C	None---------	---	---	2.0-4.0	Apparent	Apr-Jun	---	---	High------	High------	Low.
Vallers----------	C	None---------	---	---	1.0-2.5	Apparent	Nov-Jun	---	---	High------	High------	Low.

TABLE 18.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Auganaush	Fine, mixed, frigid Mollic Ochraqualfs
Barnes	Fine-loamy, mixed Udic Haploborolls
Beltrami	Fine-loamy, mixed Aquic Eutroboralfs
Cathro	Loamy, mixed, euic Terric Borosaprists
Colvin	Fine-silty, frigid Typic Calciaquolls
Darnen	Fine-loamy, mixed Pachic Udic Haploborolls
Egglake	Fine-loamy, mixed, frigid Mollic Ochraqualfs
Epoufette	Coarse-loamy, mixed, frigid Mollic Ochraqualfs
Esmond	Coarse-loamy, mixed Udorthentic Haploborolls
Fairdale	Fine-loamy, mixed (calcareous), frigid Mollic Udifluvents
Flom	Fine-loamy, mixed, frigid Typic Haplaquolls
Foldahl	Sandy over loamy, mixed Aquic Haploborolls
*Fordum	Coarse-loamy, mixed, nonacid, frigid Mollic Fluvaquents
Fram	Coarse-loamy, frigid Aeric Calciaquolls
Gonvick	Fine-loamy, mixed Aquic Argiborolls
Graycalm	Mixed, frigid Argic Udipsamments
Grimstad	Sandy over loamy, frigid Aeric Calciaquolls
Hamerly	Fine-loamy, frigid Aeric Calciaquolls
Hamlet	Fine-loamy, mixed Aquic Haploborolls
Hamre	Fine-loamy, mixed, nonacid, frigid Histic Humaquepts
Haslie	Coprogenous, euic Limnic Borosaprists
Hedman	Coarse-loamy, frigid Typic Calciaquolls
Heimdal	Coarse-loamy, mixed Udic Haploborolls
Karlstad	Coarse-loamy, mixed Aquic Eutroboralfs
Lamoure	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Langhei	Fine-loamy, mixed (calcareous), frigid Typic Udorthents
Mahkonce	Fine, mixed Aquic Eutroboralfs
Markey	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Marysland	Fine-loamy over sandy or sandy-skeletal, frigid Typic Calciaquolls
Menahga	Mixed, frigid Typic Udipsamments
Naytahwaush	Fine, montmorillonitic Mollic Eutroboralfs
Nebish	Fine-loamy, mixed Typic Eutroboralfs
Quam	Fine-silty, mixed, frigid Cumulic Haplaquolls
Rockwell	Coarse-loamy, frigid Typic Calciaquolls
Rothsay	Coarse-silty, mixed Udic Haploborolls
Sandberg	Sandy, mixed Udorthentic Haploborolls
Seelyeville	Euic Typic Borosaprists
Snellman	Fine-loamy, mixed Typic Eutroboralfs
Sugarbush	Coarse-loamy, mixed Typic Eutroboralfs
Sverdrup	Sandy, mixed Udic Haploborolls
Talmoon	Fine-loamy, mixed, frigid Mollic Ochraqualfs
Two Inlets	Sandy, mixed Psammentic Eutroboralfs
Udipsamments	Udipsamments
Urness	Fine-silty, mixed (calcareous), frigid Mollic Fluvaquents
Vallers	Fine-loamy, frigid Typic Calciaquolls
Waukon	Fine-loamy, mixed Mollic Eutroboralfs
Wykeham	Fine-loamy, mixed Aquic Eutroboralfs

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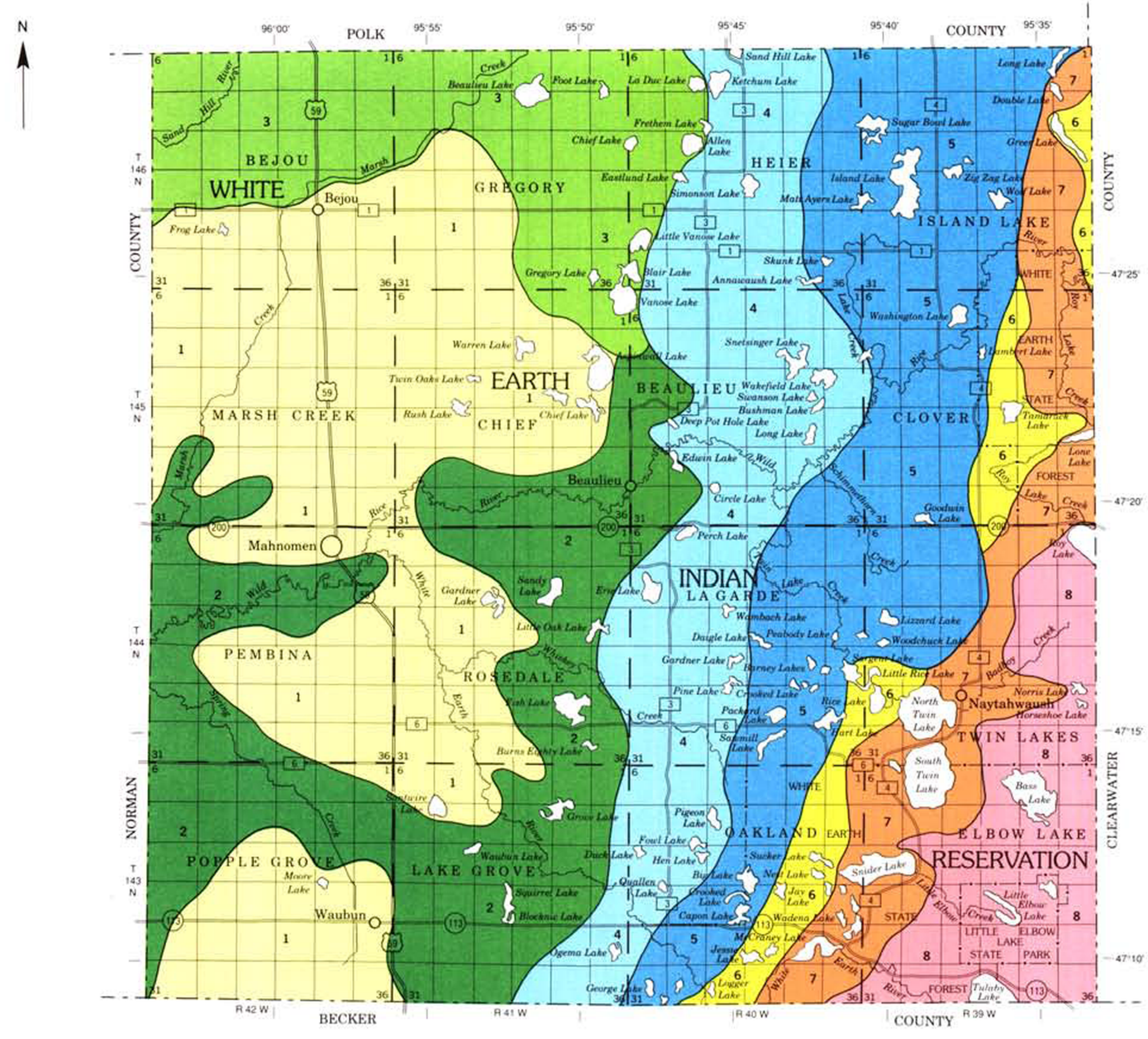


Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SOIL LEGEND*

1	HAMERLY-VALLERS association
2	BARNES-LANGHEI association
3	HEDMAN-FRAM-HEIMDAL association
4	WAUKON-LANGHEI-FLOM association
5	NAYTAHWAUSH-MAHKONCE-AUGANAUSH association
6	NEBISH-BELTRAMI association
7	SUGARBUSH-GRAYCALM association
8	SNELLMAN-SUGARBUSH association

*The units on this legend are described in the text under the heading "General Soil Map Units."

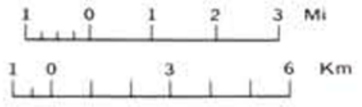
Compiled 1996

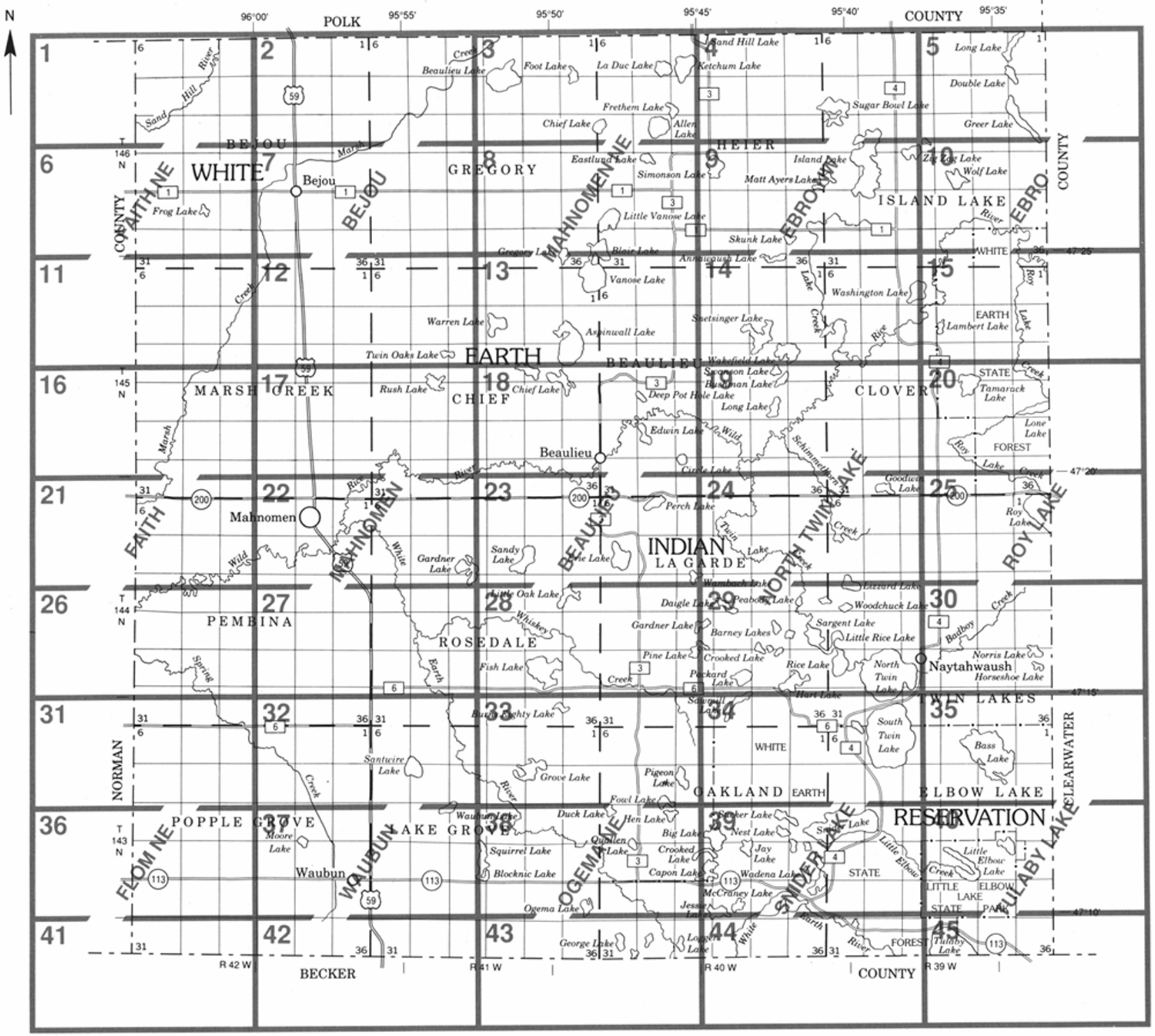
SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
MINNESOTA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
MAHNOMEN COUNTY, MINNESOTA





INDEX TO MAP SHEETS
MAHNOMEN COUNTY, MINNESOTA

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 following the slope letter indicates that the soil is moderately eroded.

SYMBOL	NAME
33B	Barnes loam, 2 to 6 percent slopes
36	Flom silty clay loam
38B	Waukon loam, 2 to 8 percent slopes
38C	Waukon loam, 8 to 15 percent slopes
38E	Waukon loam, 15 to 30 percent slopes
40B	Nebish loam, 2 to 8 percent slopes
40C	Nebish loam, 8 to 15 percent slopes
40E	Nebish loam, 15 to 30 percent slopes
59	Grimstad sandy loam
63	Rockwell loam
121	Wykeham fine sandy loam
125	Beltrami loam
127B	Sverdrup sandy loam, 1 to 6 percent slopes
180	Gonvick loam
191	Epoufette sandy loam
205	Karlstad sandy loam
236	Vallers silty clay loam
267B	Snellman sandy loam, 2 to 8 percent slopes
267C	Snellman sandy loam, 8 to 15 percent slopes
267E	Snellman sandy loam, 15 to 30 percent slopes
290B	Rothsay silt loam, 1 to 6 percent slopes
296	Fram loam
332B	Sugarbush sandy loam, 1 to 8 percent slopes
335	Urness mucky silt loam
344	Quam silty clay loam
346	Talmoon loam
352B	Heimdal loam, 2 to 6 percent slopes
426	Foldahl sandy loam
494B	Darnen loam, 2 to 6 percent slopes
540	Seelyeville muck
543	Markey muck
544	Cathro muck
718B	Naytahwaush loam, 2 to 8 percent slopes
718C	Naytahwaush loam, 8 to 15 percent slopes
718E	Naytahwaush loam, 15 to 30 percent slopes
737	Mahkonce loam
746	Haslie muck
748	Hamlet loam
749	Colvin silt loam, occasionally flooded
767	Auganaush loam
775B	Sugarbush-Two Inlets complex, 1 to 8 percent slopes
775C	Sugarbush-Two Inlets complex, 8 to 15 percent slopes
776B	Snellman-Sugarbush complex, 2 to 8 percent slopes
776C	Snellman-Sugarbush complex, 8 to 15 percent slopes
776E	Snellman-Sugarbush complex, 15 to 30 percent slopes
827B	Heimdal-Esmond complex, 2 to 6 percent slopes
827C2	Heimdal-Esmond complex, 6 to 12 percent slopes, eroded
867B	Graycalm-Menahga complex, 1 to 8 percent slopes
903B	Barnes-Langhei complex, 2 to 6 percent slopes
903C2	Barnes-Langhei complex, 6 to 12 percent slopes, eroded
942D2	Langhei-Barnes complex, 12 to 20 percent slopes, eroded
967B	Waukon-Langhei complex, 2 to 6 percent slopes
967C2	Waukon-Langhei complex, 6 to 12 percent slopes, eroded
979D2	Langhei-Waukon complex, 12 to 20 percent slopes, eroded
1030	Pits, gravel-Udipsamments complex
1113	Haslie, Seelyeville, and Cathro soils, ponded
1117	Hedman loam
1139	Marysland loam, occasionally flooded
1142	Hedman-Fram complex
1147	Fordum, Fairdale, and Lamoure soils, frequently flooded
1148	Fairdale and Lamoure soils, occasionally flooded
1149	Hamerly clay loam
1152B	Sugarbush loamy sand, 1 to 8 percent slopes
1152C	Sugarbush loamy sand, 8 to 15 percent slopes
1152E	Sugarbush loamy sand, 15 to 30 percent slopes
1200	Egglake loam
1238E	Two Inlets-Sugarbush complex, 15 to 30 percent slopes
1233D2	Esmond-Heimdal complex, 12 to 20 percent slopes, eroded
1241B	Sandberg sandy loam, 1 to 6 percent slopes
1804	Hamre muck, ponded
1825B	Seelyeville muck, sloping, seep land
1878	Hamre muck
1967	Hamerly-Vallers complex

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES	
County or parish	——— –
Reservation (national forest or park, state forest or park, and large airport)	—— · ——
Field sheet matchline and neatline	————
AD HOC BOUNDARY (label)	
Small airport, airfield, park, oilfield, cemetery, or flood pool	Davis Airstri ┼ - - ⌄ - -
STATE COORDINATE TICK	1 890 000 FEET
LAND DIVISION CORNER (sections and land grants)	└ ┴ ┼ ┼
ROAD EMBLEM & DESIGNATIONS	
Federal	58
State	200
PITS	
Gravel pit	⚒

WATER FEATURES

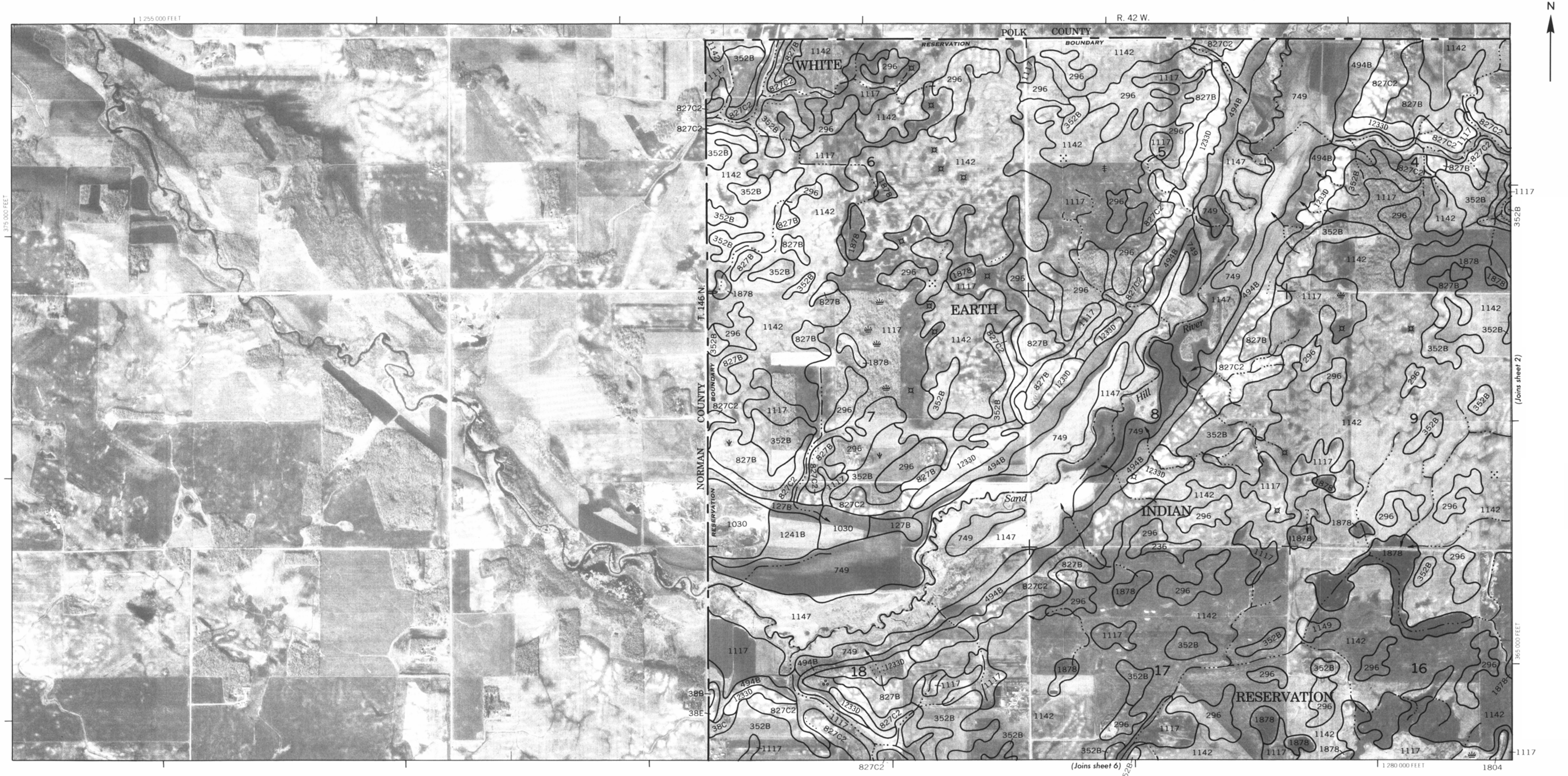
DRAINAGE	
Perennial, single line	‿
Intermittent	⋯⌒⋯
Drainage end	⌄→
Canals or ditches	
Drainage and/or irrigation	➝— · —
LAKES, PONDS AND RESERVOIRS	
Perennial	water w
MISCELLANEOUS WATER FEATURES	
Marsh or swamp	ᴪ
Spring	o~
Wet spot*	Ψ

* Not to be used with poorly and very poorly drained soils

SPECIAL SYMBOLS FOR SOIL SURVEY

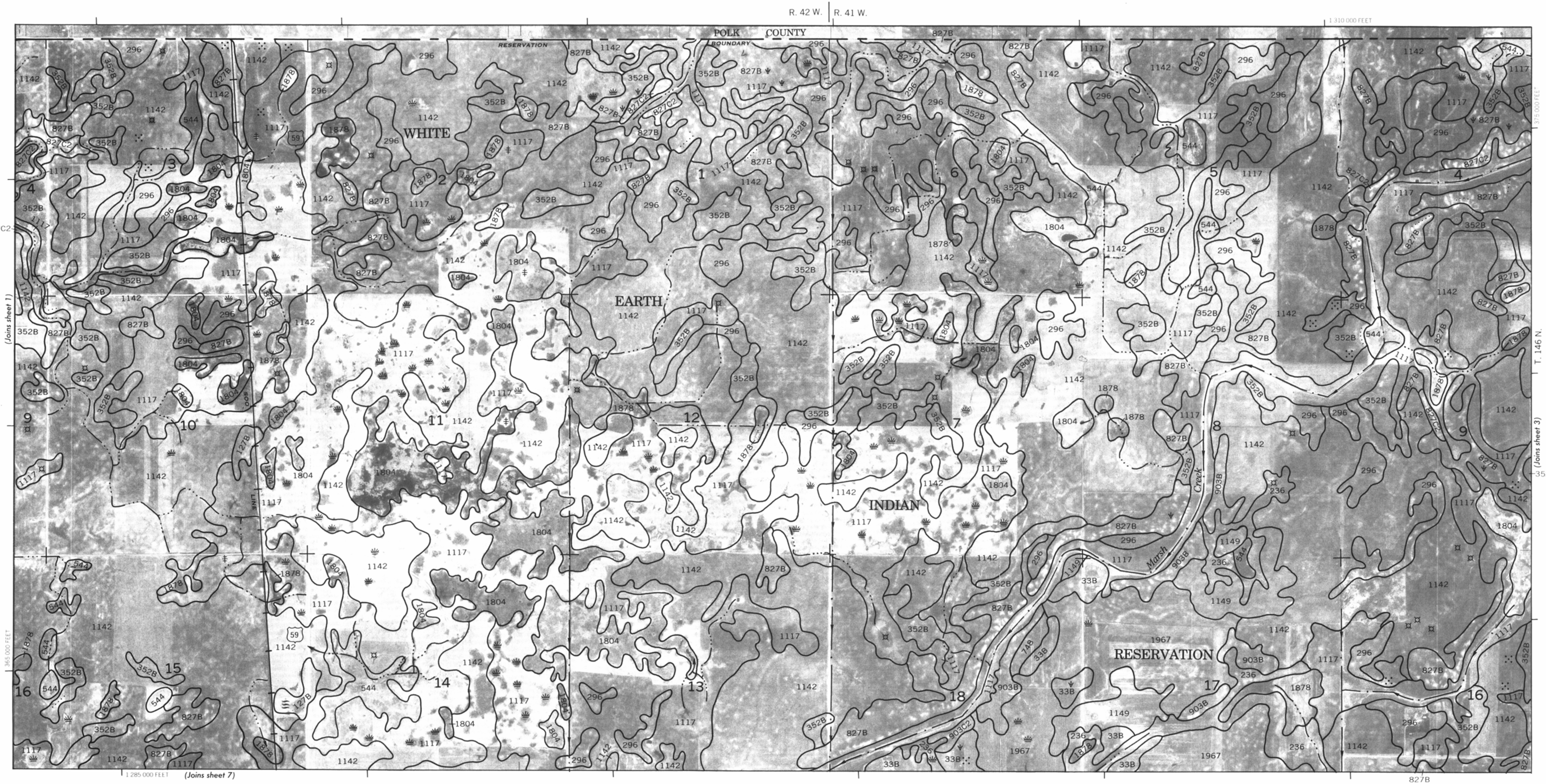
SOIL DELINEATIONS AND SYMBOLS	184 ⟩⟨ 236
ESCARPMENTS	
Other than bedrock (points down slope)	▾▾▾▾▾▾▾▾▾▾▾
SHORT STEEP SLOPE	···········
MISCELLANEOUS	
Gravelly spot	∘∘∘
Dumps and other similar nonsoil areas	≡
Sandy spot	⁙
Very stony spot	ꝏ
Organic spot	¤
Better drained soil in poorly drained area	ǂ

SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 1

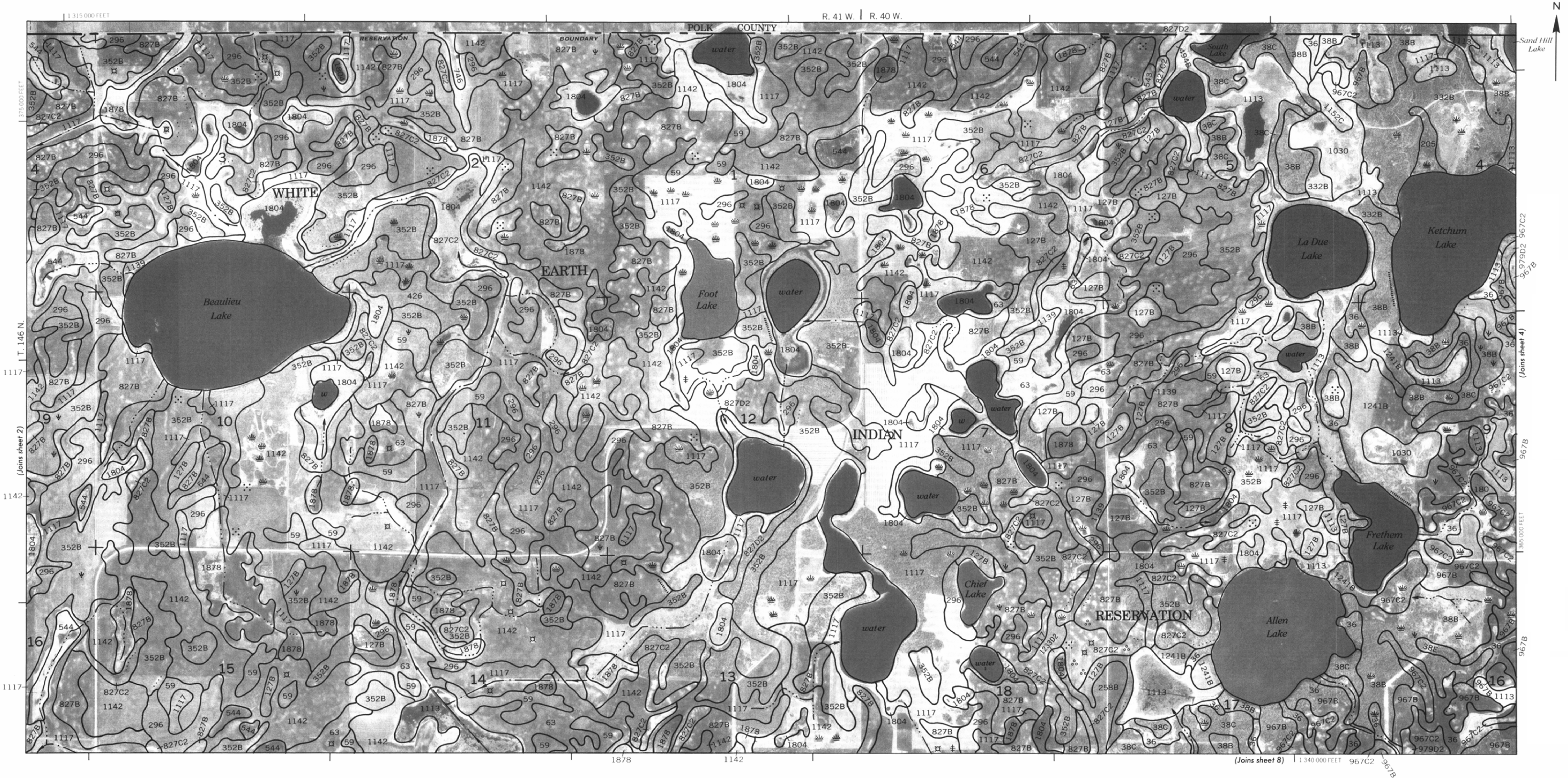


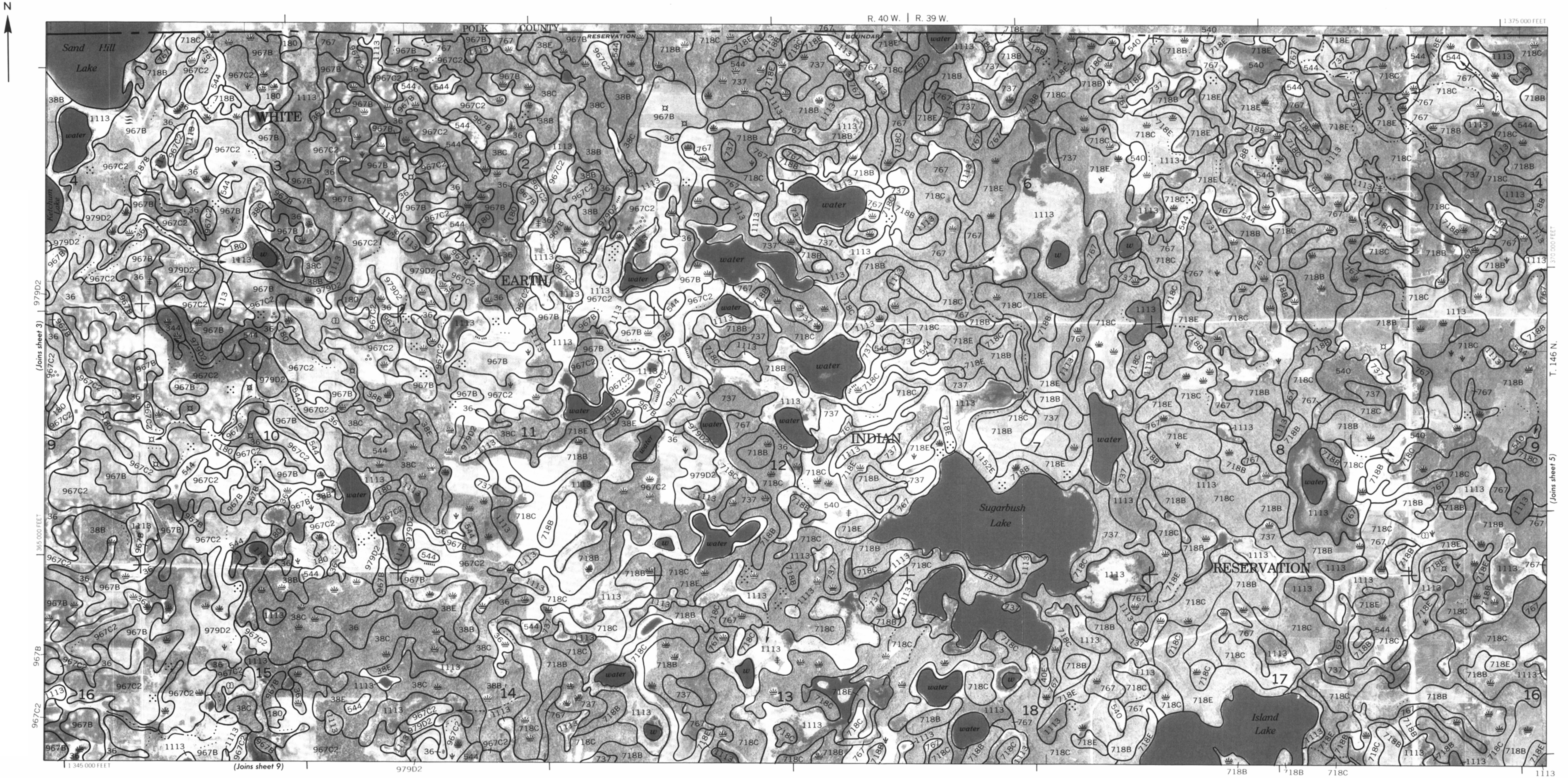
② N

SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 2

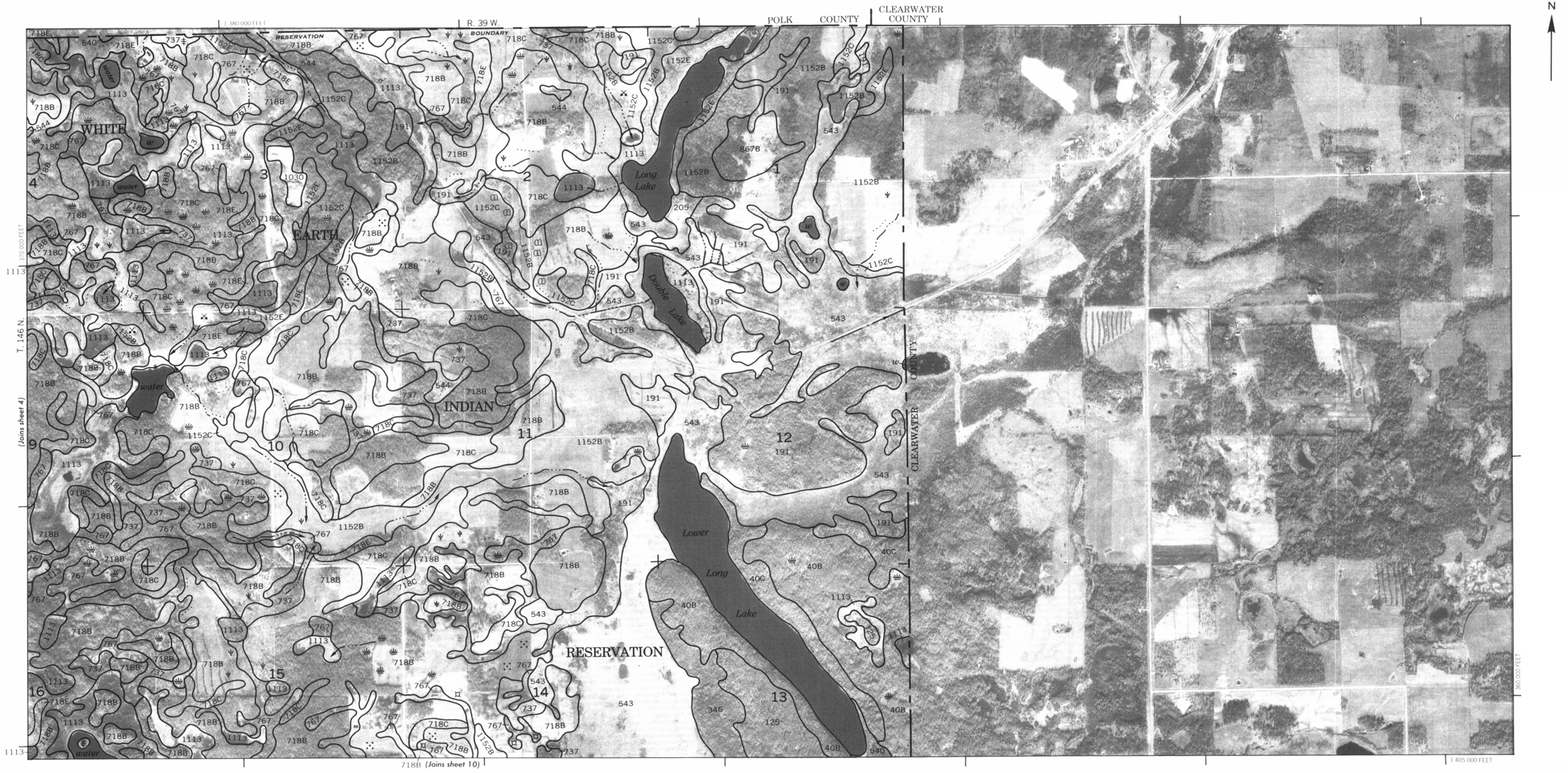


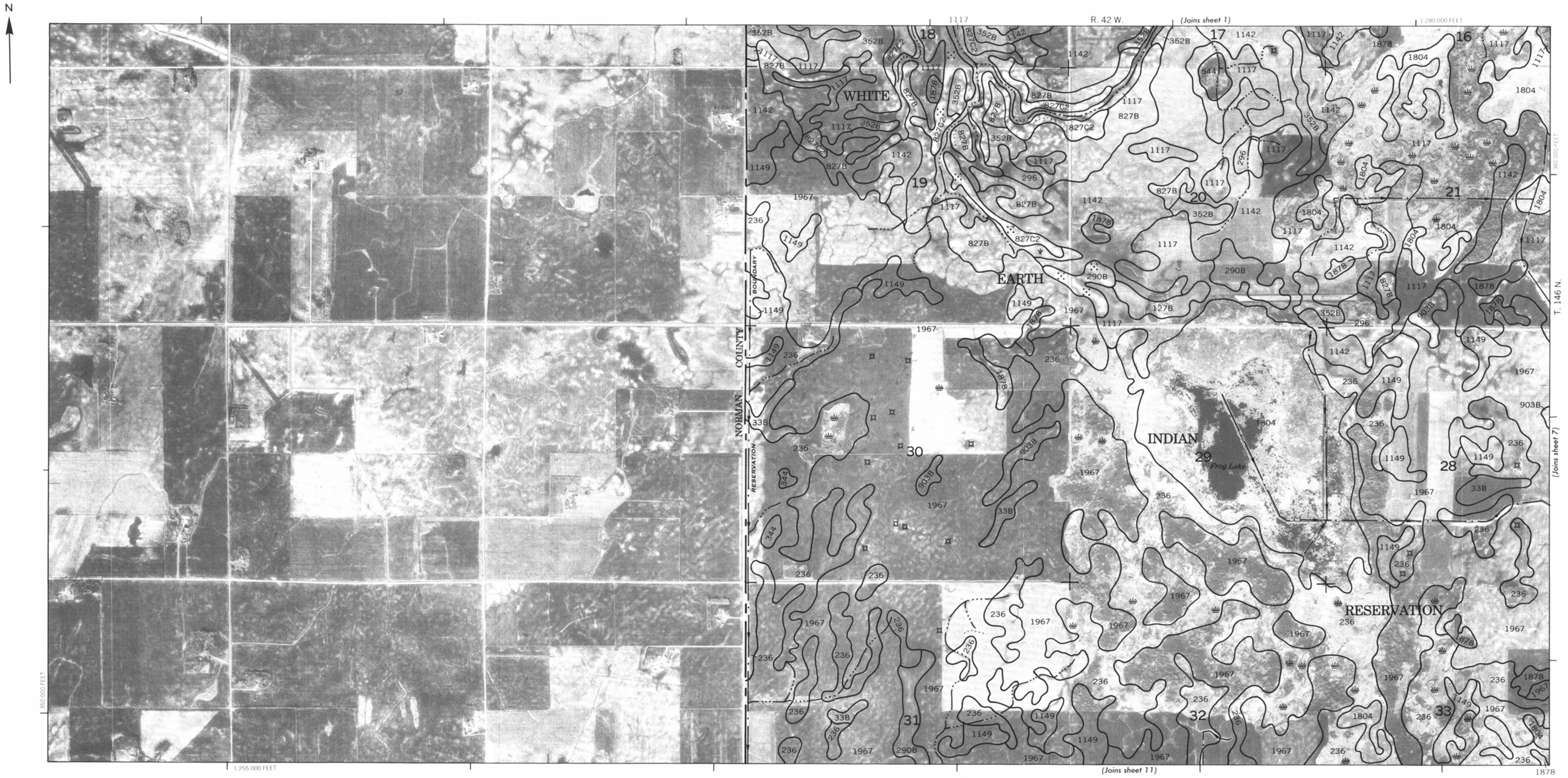
SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 3

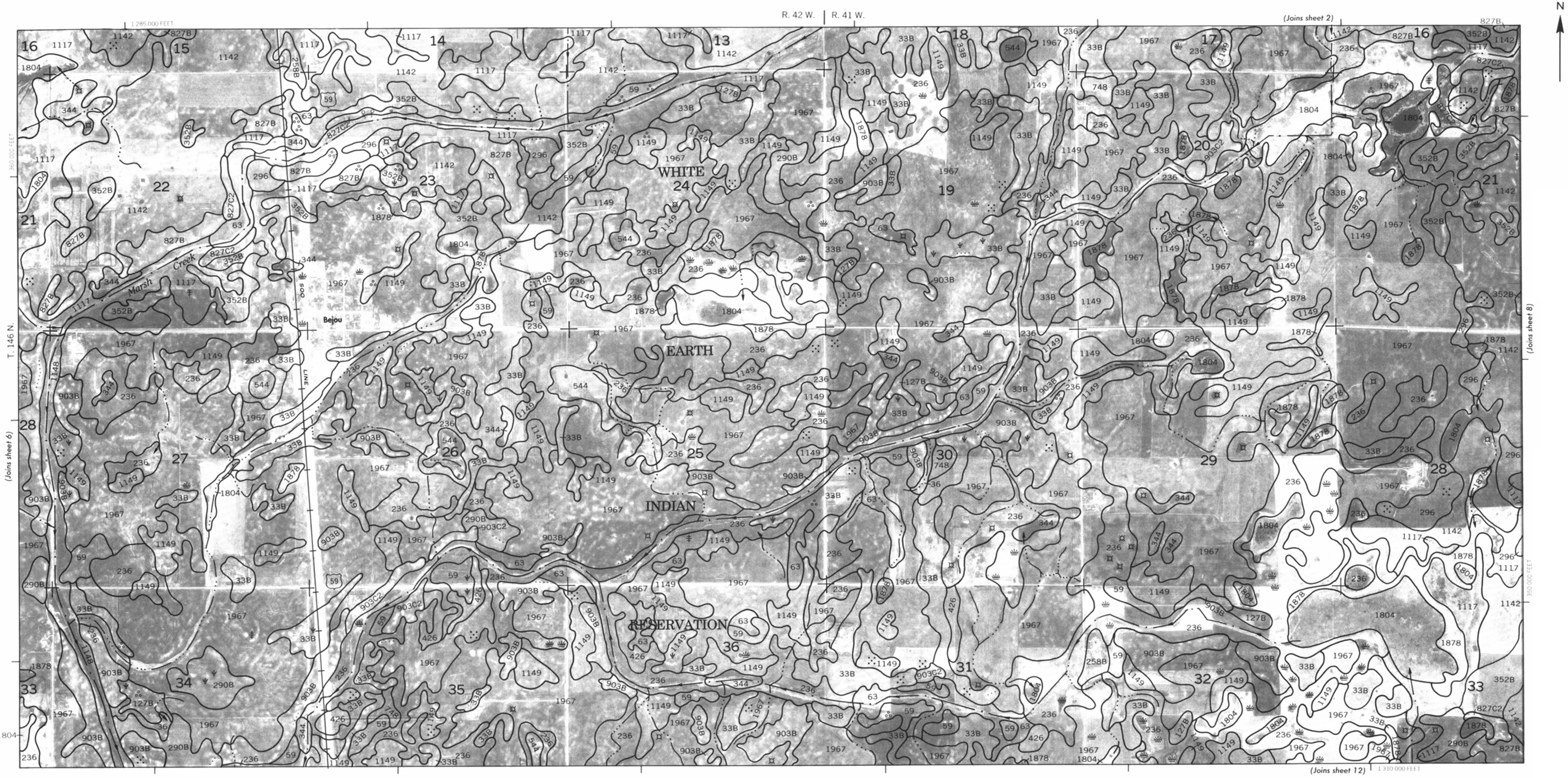



N
R. 40 W. | R. 39 W.
1 375 000 FEET
POLK COUNTY
RESERVATION BOUNDARY
Sand Hill Lake
Ketchum Lake
WHITE
EARTH
INDIAN
RESERVATION
Sugarbush Lake
Island Lake
water
w
370 000 FEET
365 000 FEET
1 345 000 FEET
T. 146 N.
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 9)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
36
38B
38C
38E
180
540
544
718B
718C
718E
737
767
967B
967C2
979D2
1113
1152E

SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 5




N
(Joins sheet 1)
R. 42 W.
1117
1 280 000 FEET
360 000 FEET
T. 146 N.
(Joins sheet 7)
(Joins sheet 11)
1 255 000 FEET
350 000 FEET
1878
WHITE
EARTH
INDIAN
RESERVATION
NORMAN
COUNTY
RESERVATION
BOUNDARY
Frog Lake
16
17
18
19
20
21
28
29
30
31
32
33
33B
127B
236
290B
296
344
352B
827B
827C2
903B
1117
1142
1149
1804
1878
1967


N
R. 42 W.
R. 41 W.
(Joins sheet 2)
1 285 000 FEET
360 000 FEET
T. 146 N.
(Joins sheet 6)
(Joins sheet 8)
(Joins sheet 12)
1 310 000 FEET
WHITE
EARTH
INDIAN
RESERVATION
Bejou
LINE
Marsh
Creek
16
15
14
13
18
17
16
21
22
23
24
19
20
21
28
27
26
25
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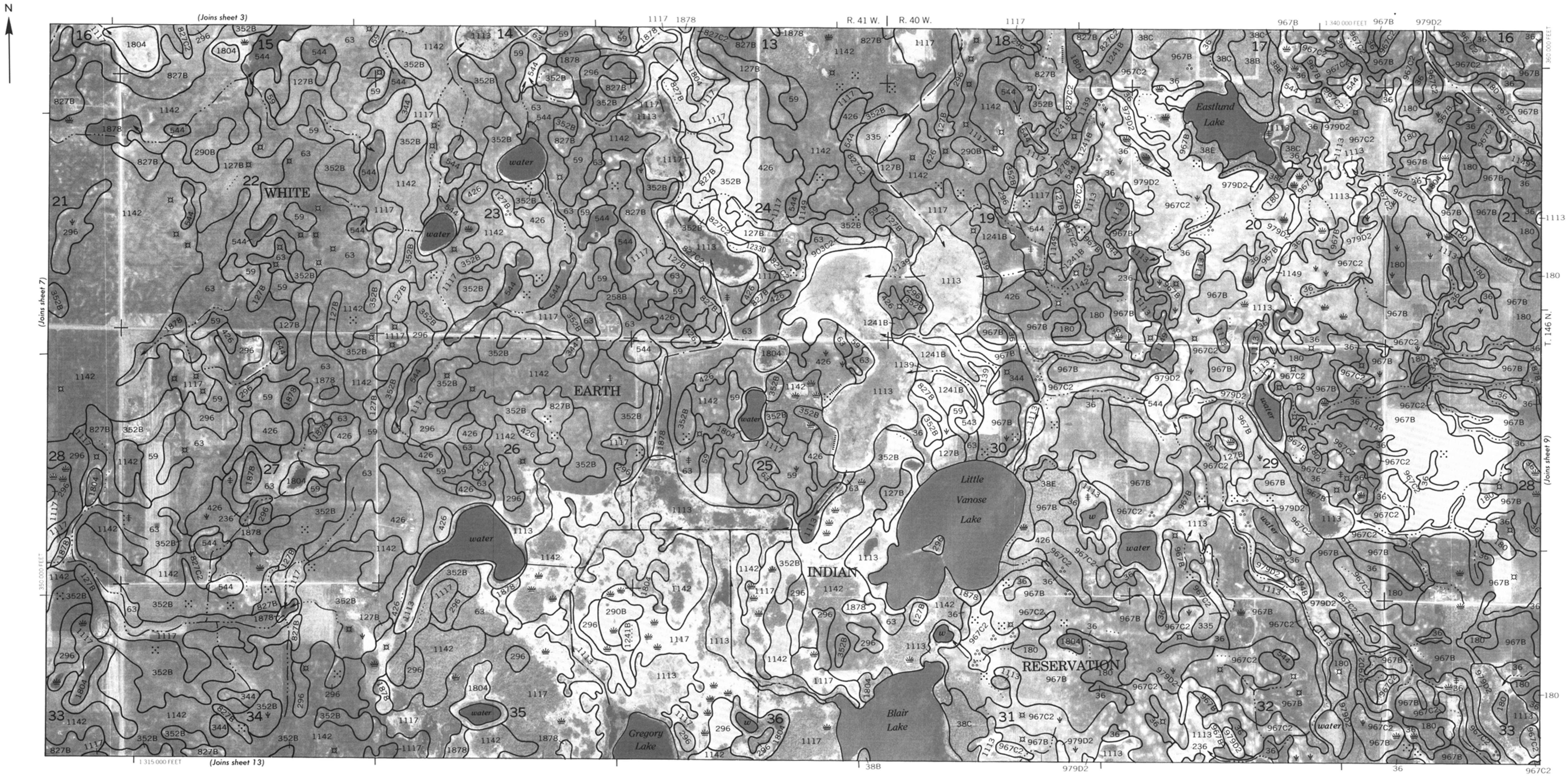
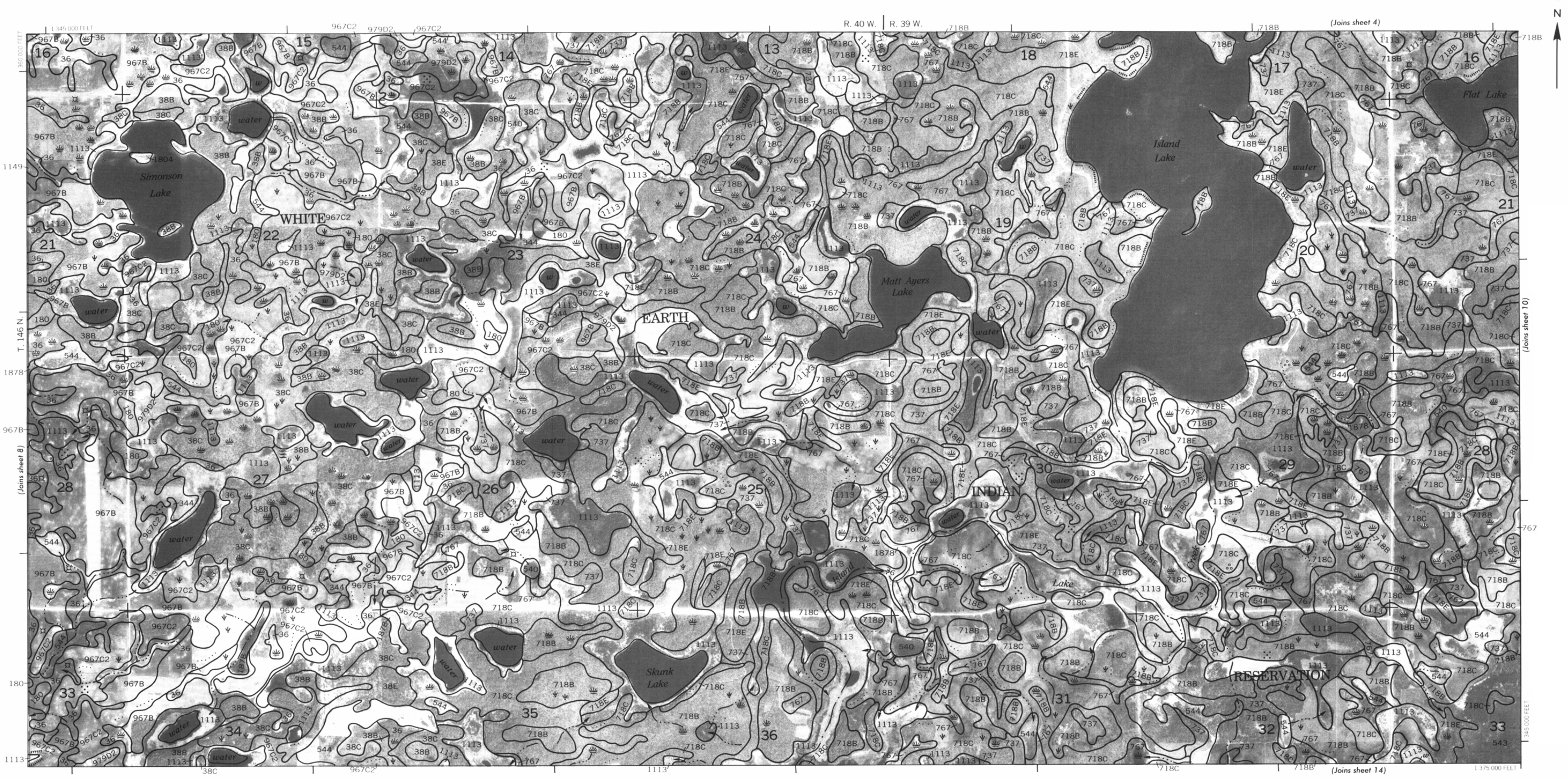
33

SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 8

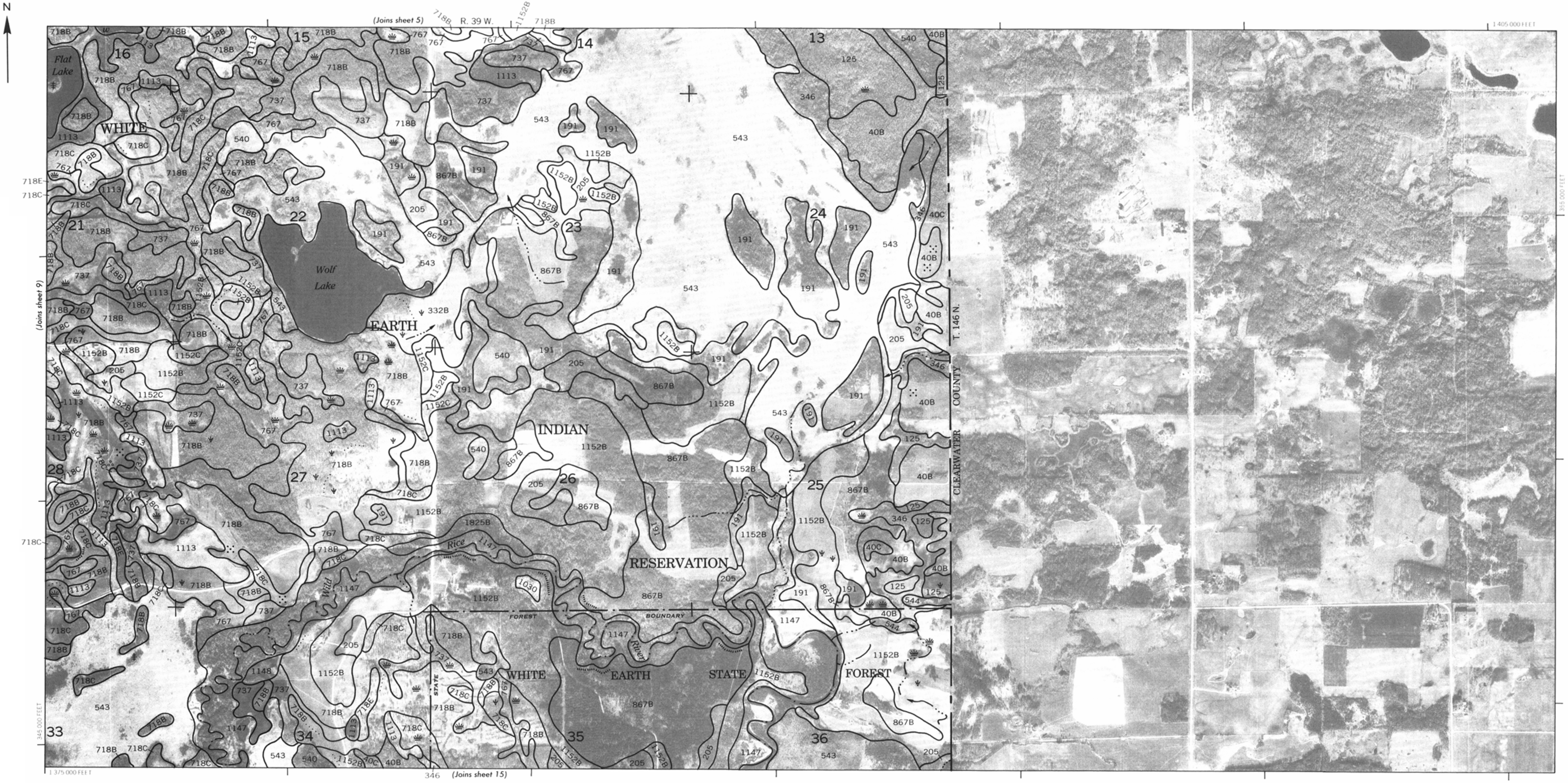


SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 9

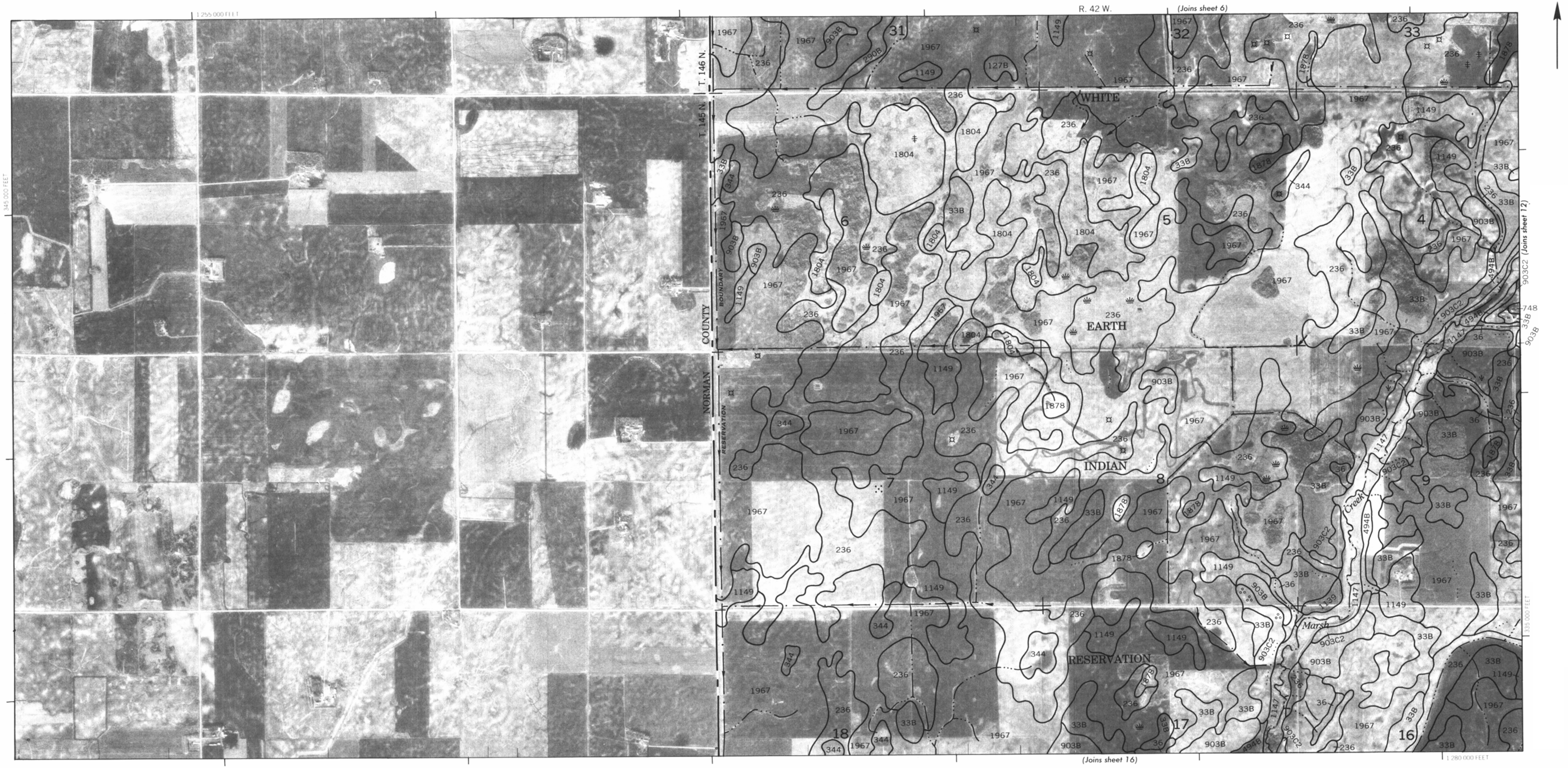


⑩

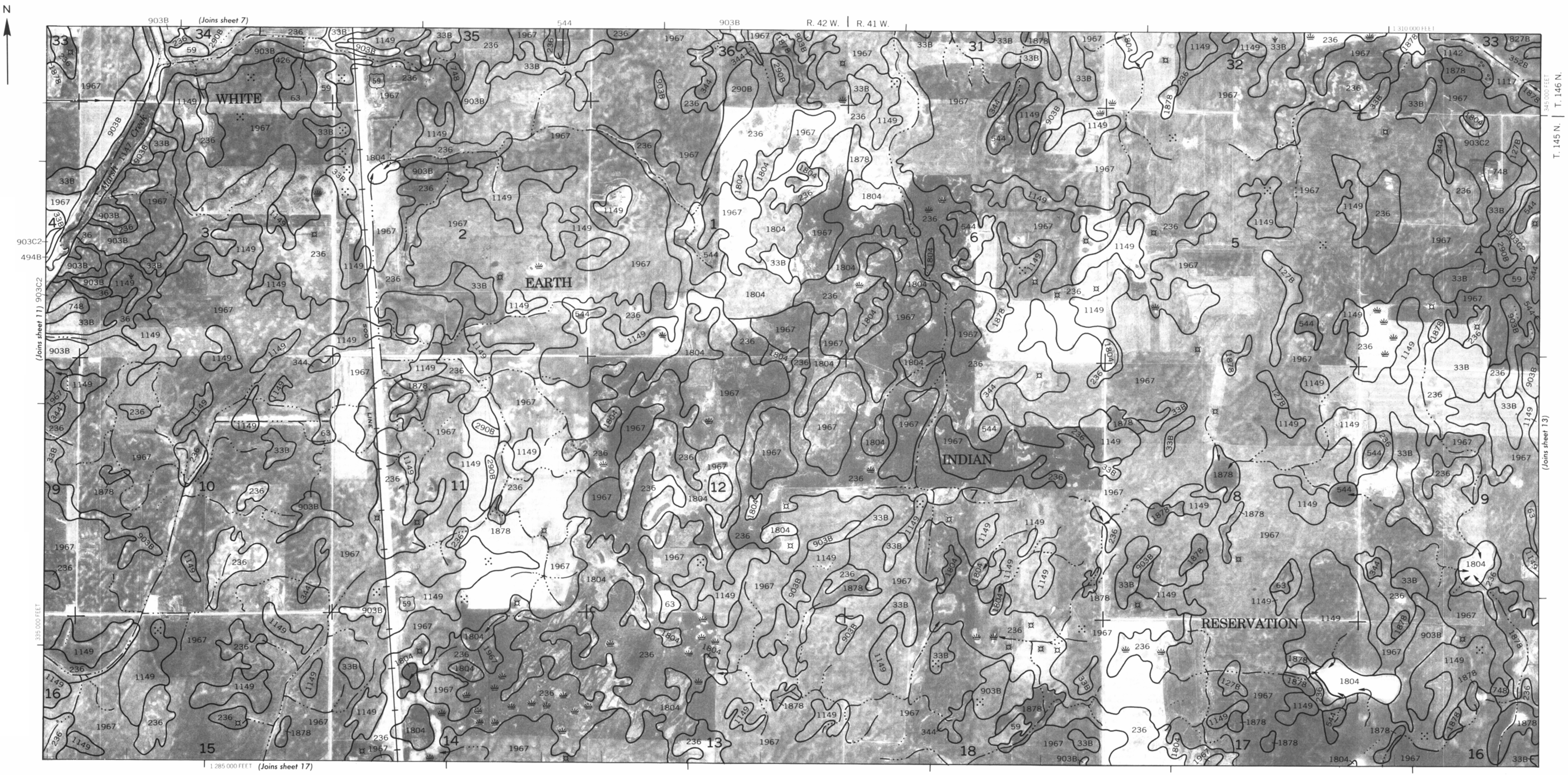
SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 10

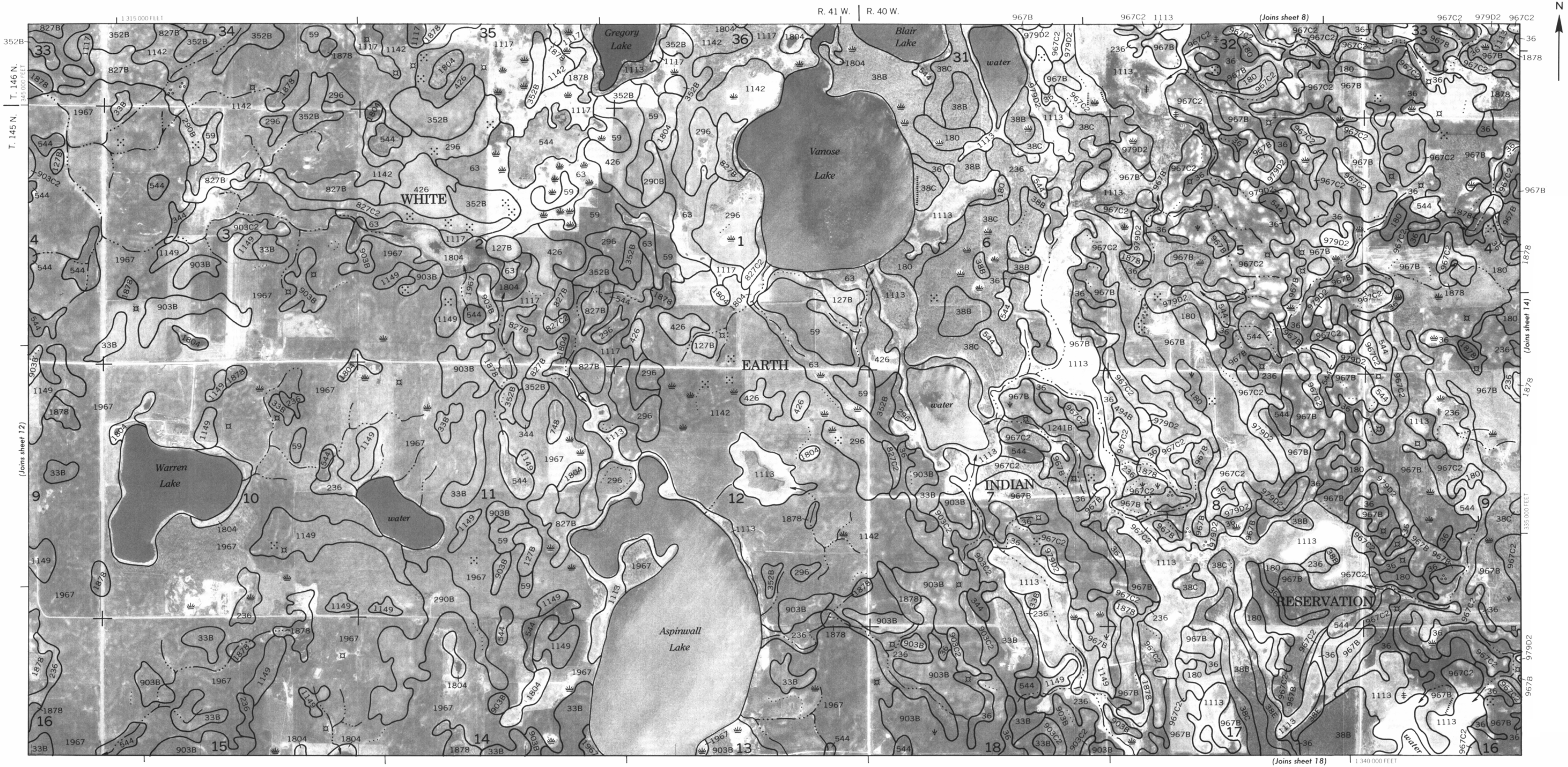


SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 11

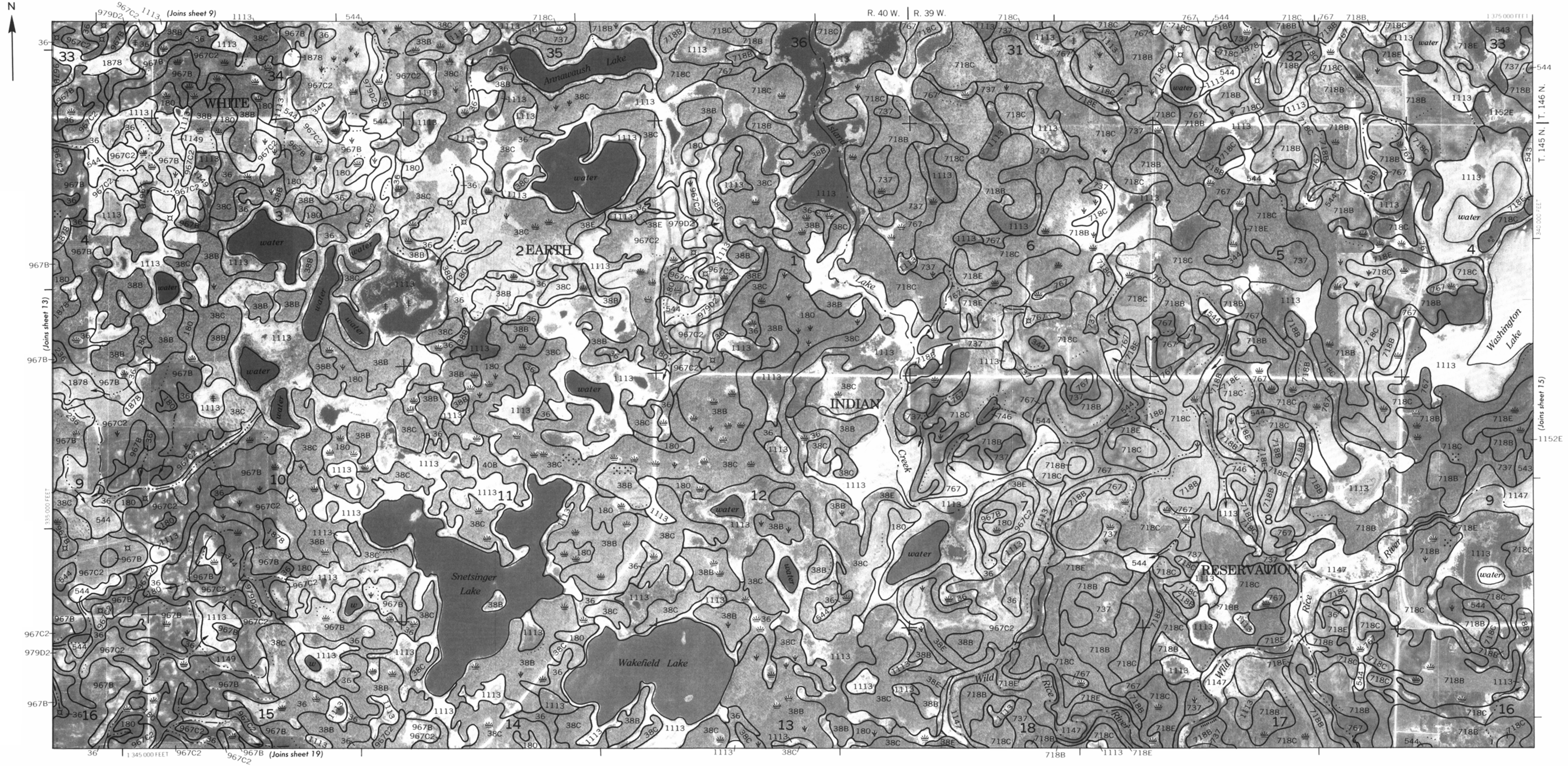


SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 12




N
R. 41 W.
R. 40 W.
T. 146 N.
T. 145 N.
1 315 000 FEET
345 000 FEET
335 000 FEET
1 340 000 FEET
(Joins sheet 8)
(Joins sheet 14)
(Joins sheet 18)
(Joins sheet 12)
Gregory Lake
Blair Lake
Vanose Lake
Warren Lake
Aspinwall Lake
water
WHITE
EARTH
INDIAN
RESERVATION
33
34
35
36
31
32
33
4
3
2
1
6
5
4
9
10
11
12
7
8
9
16
15
14
13
18
17
16

SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 14



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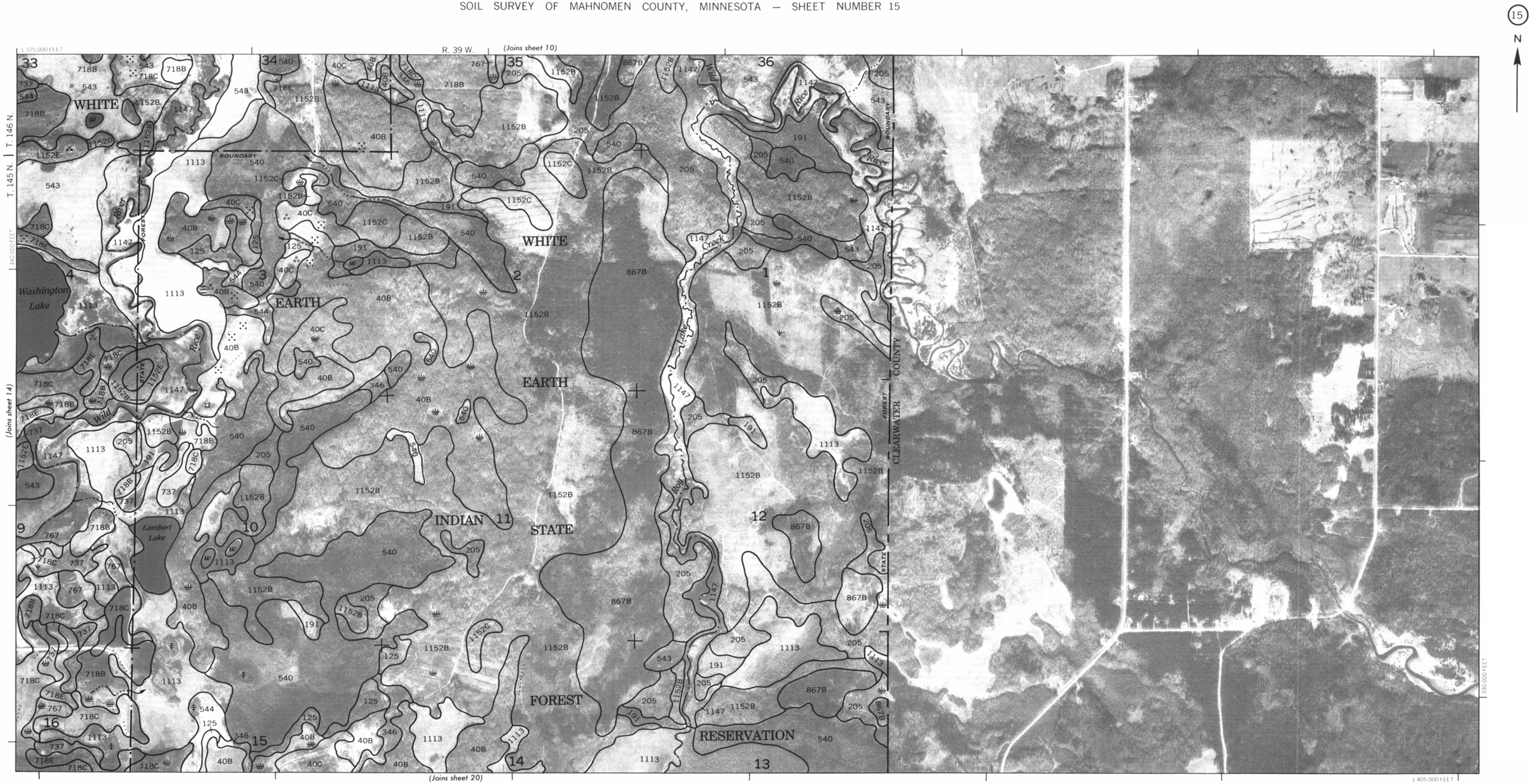
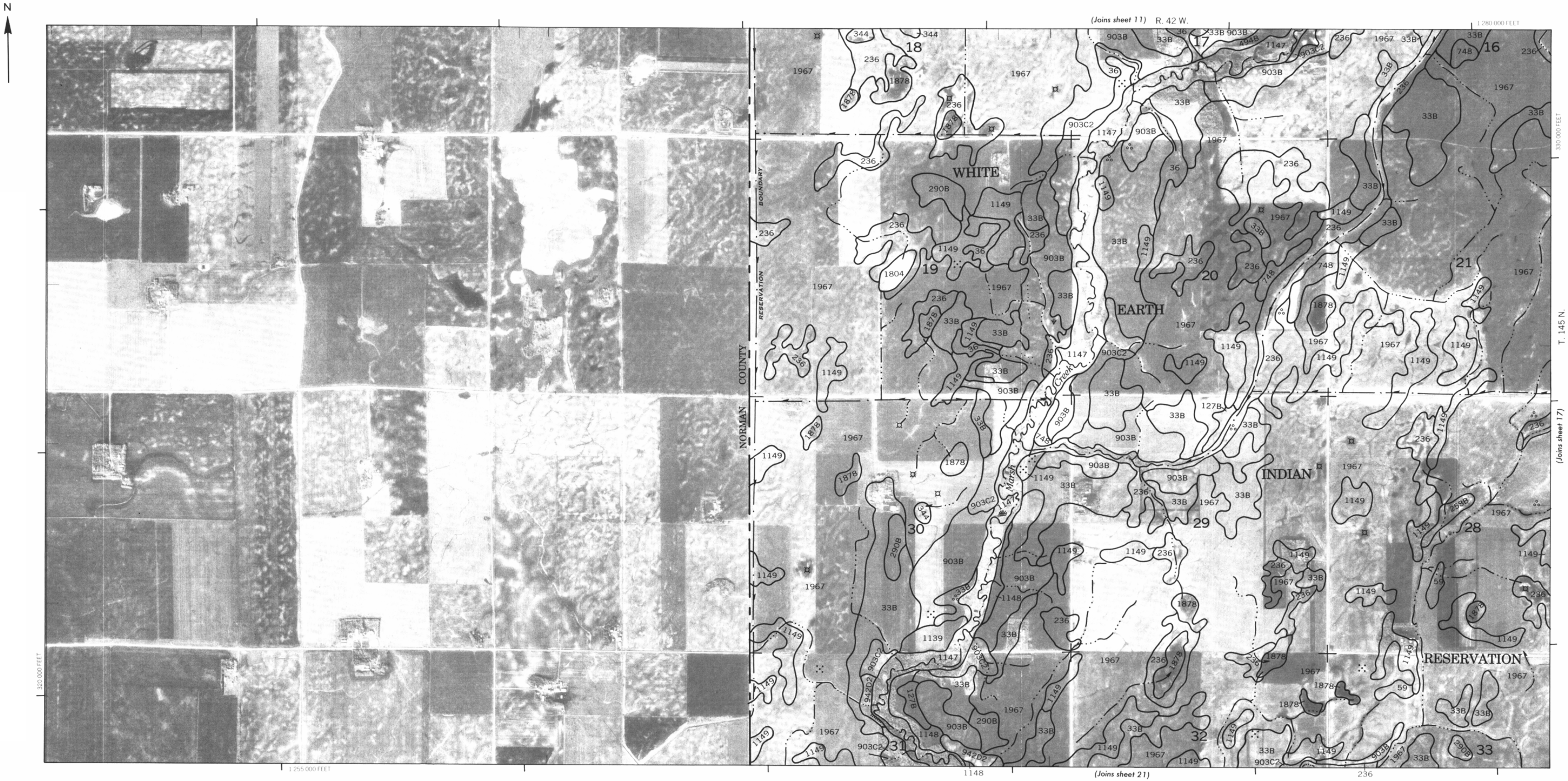
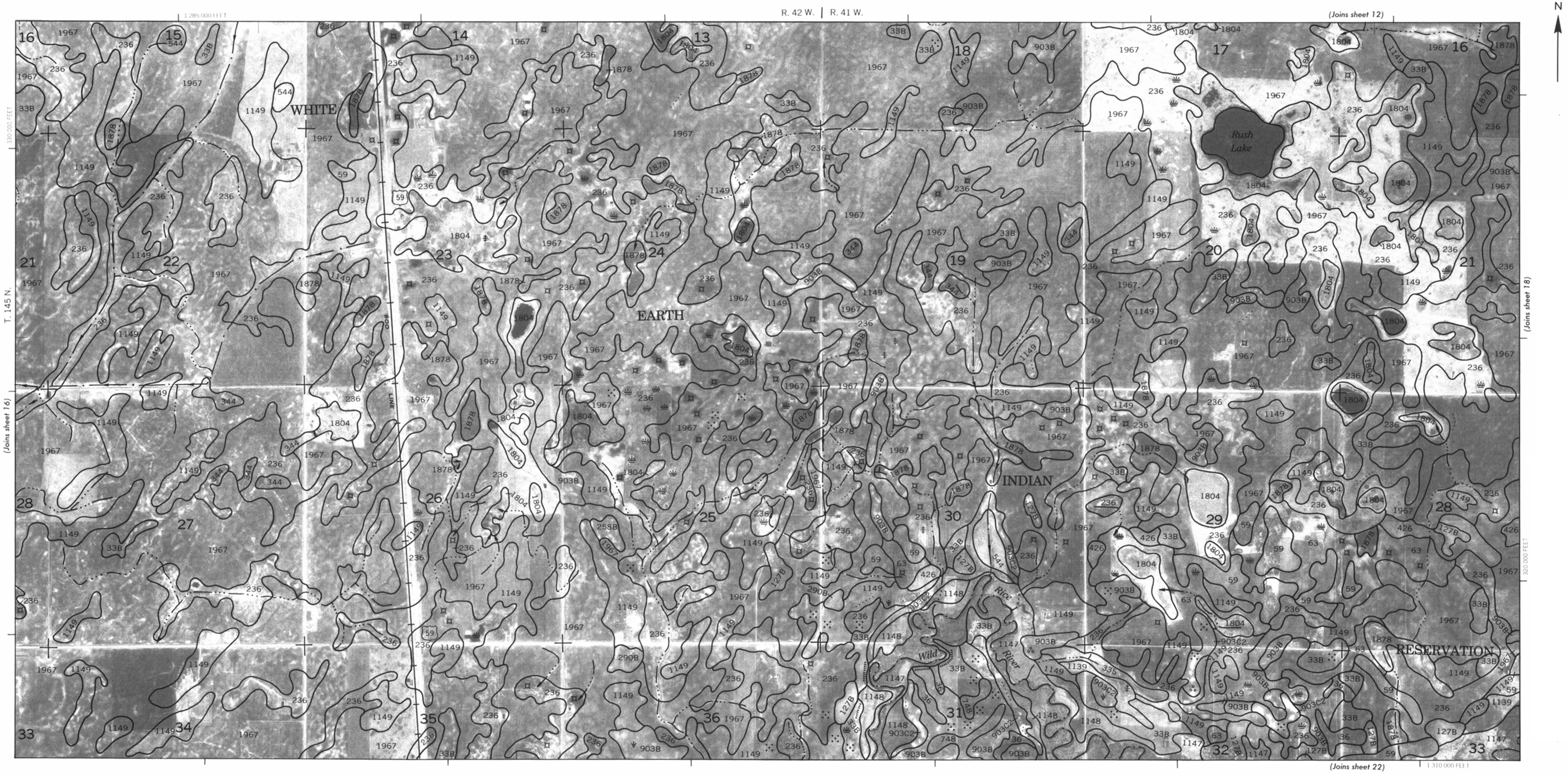


SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 16

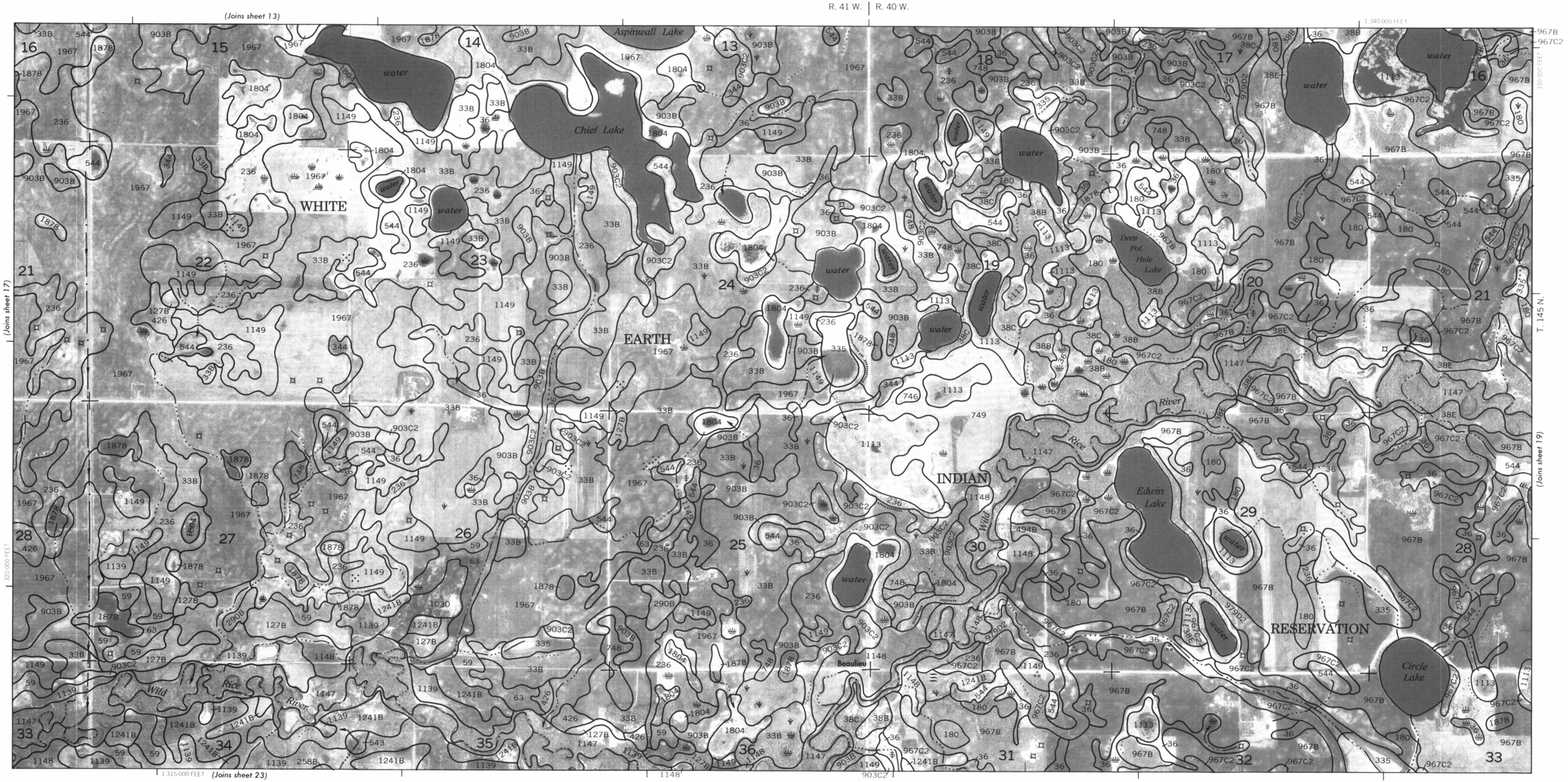


SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 17



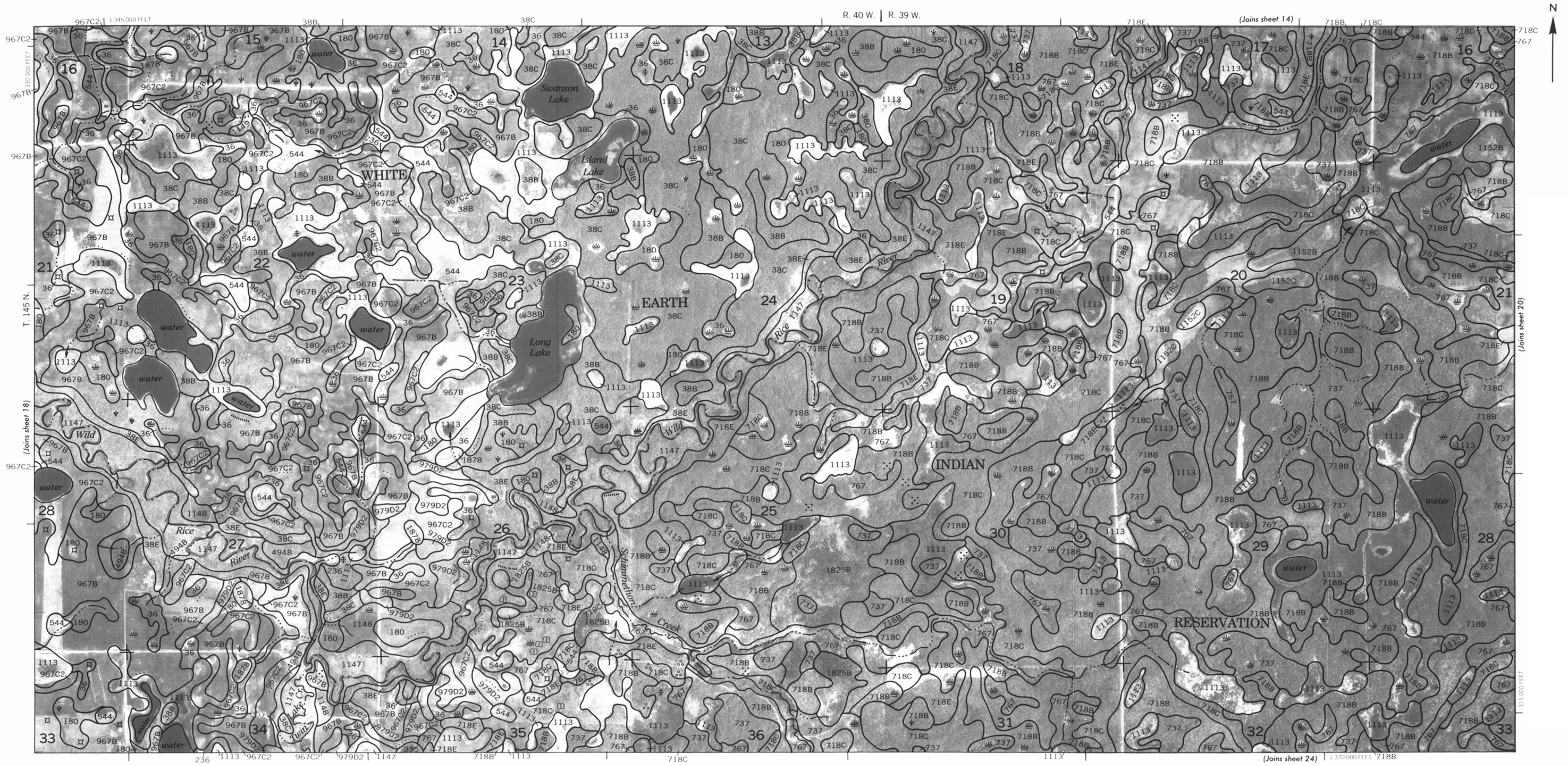
SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 18

N ↑

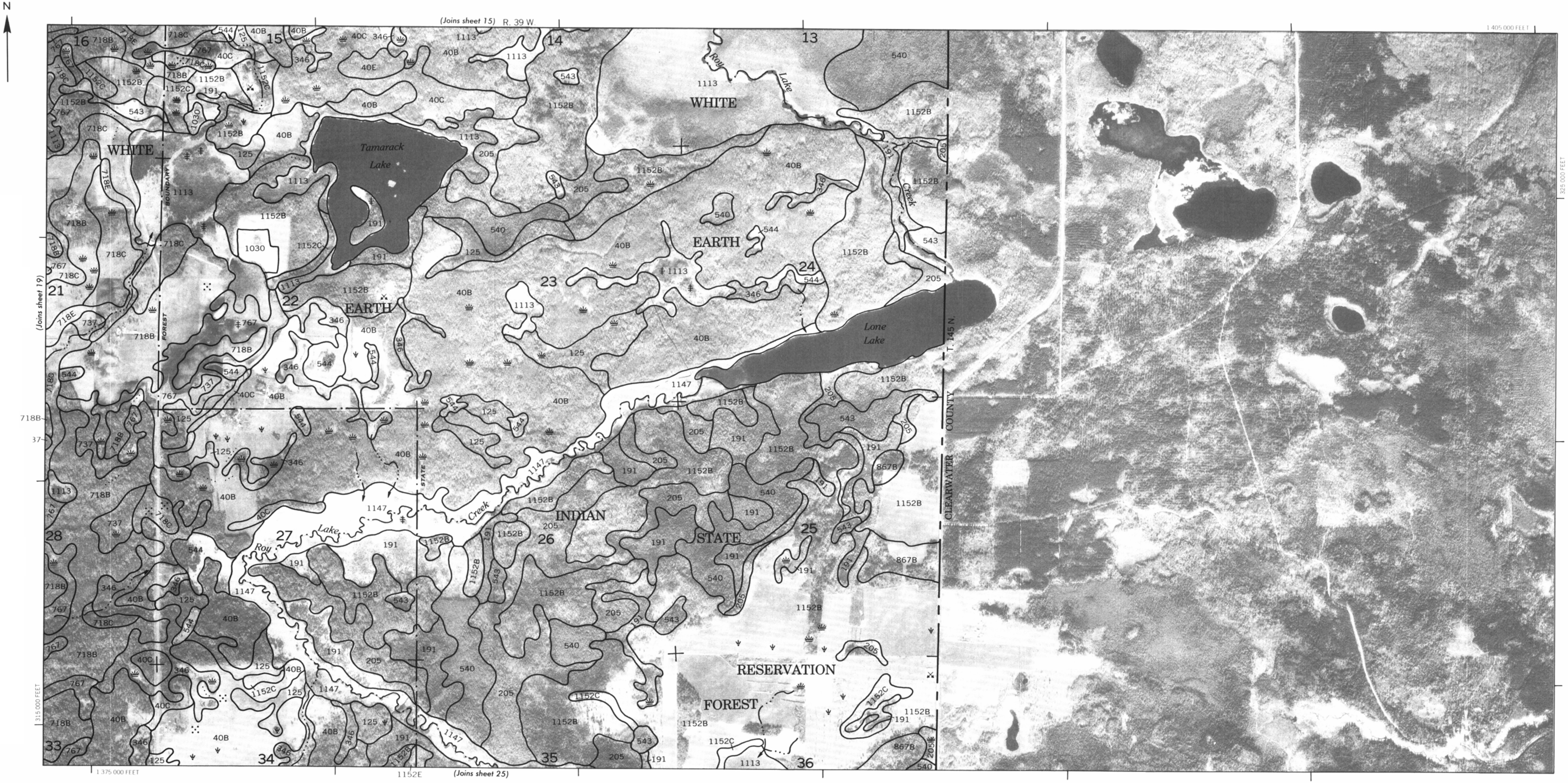


SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 19

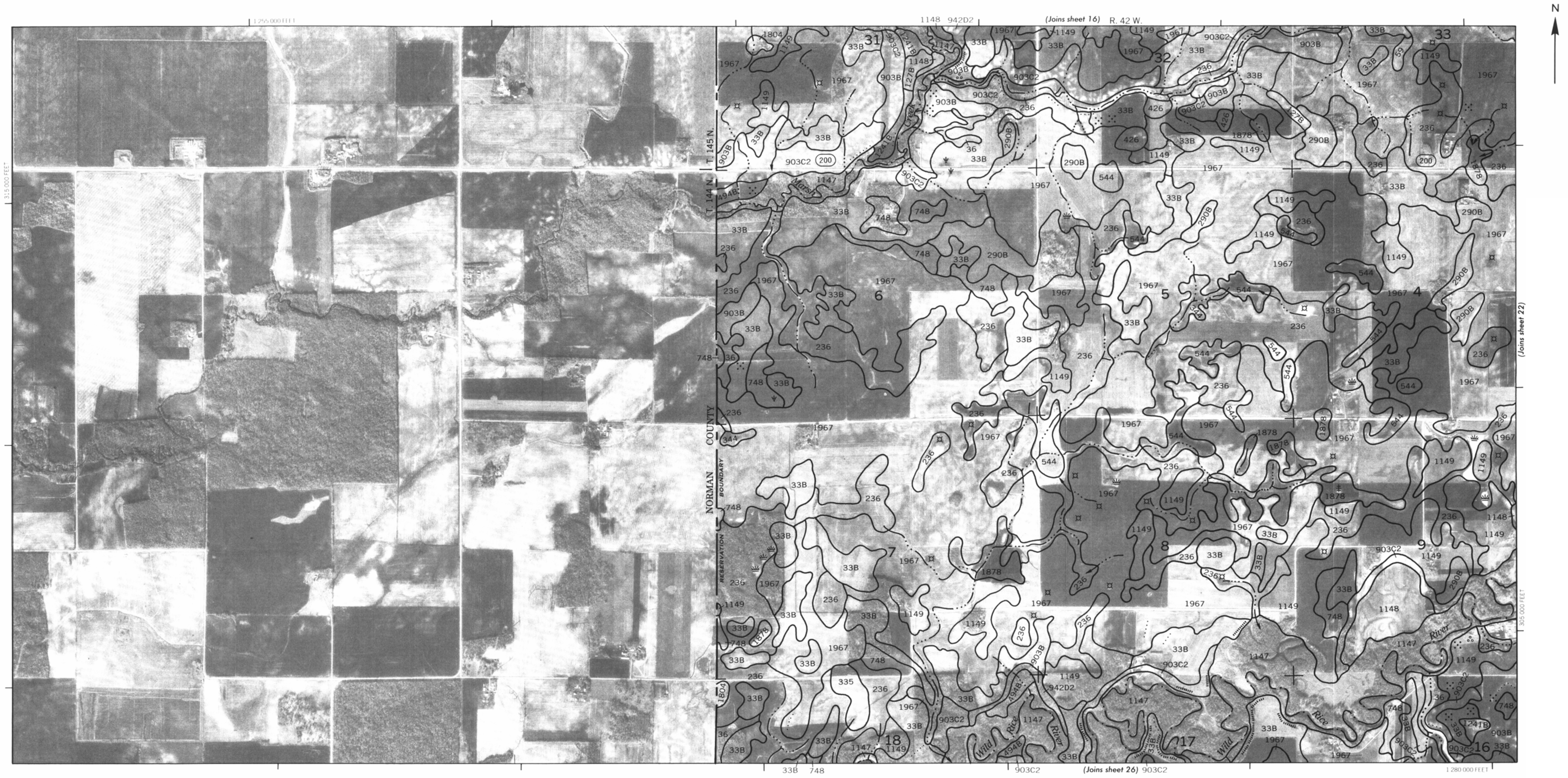
19

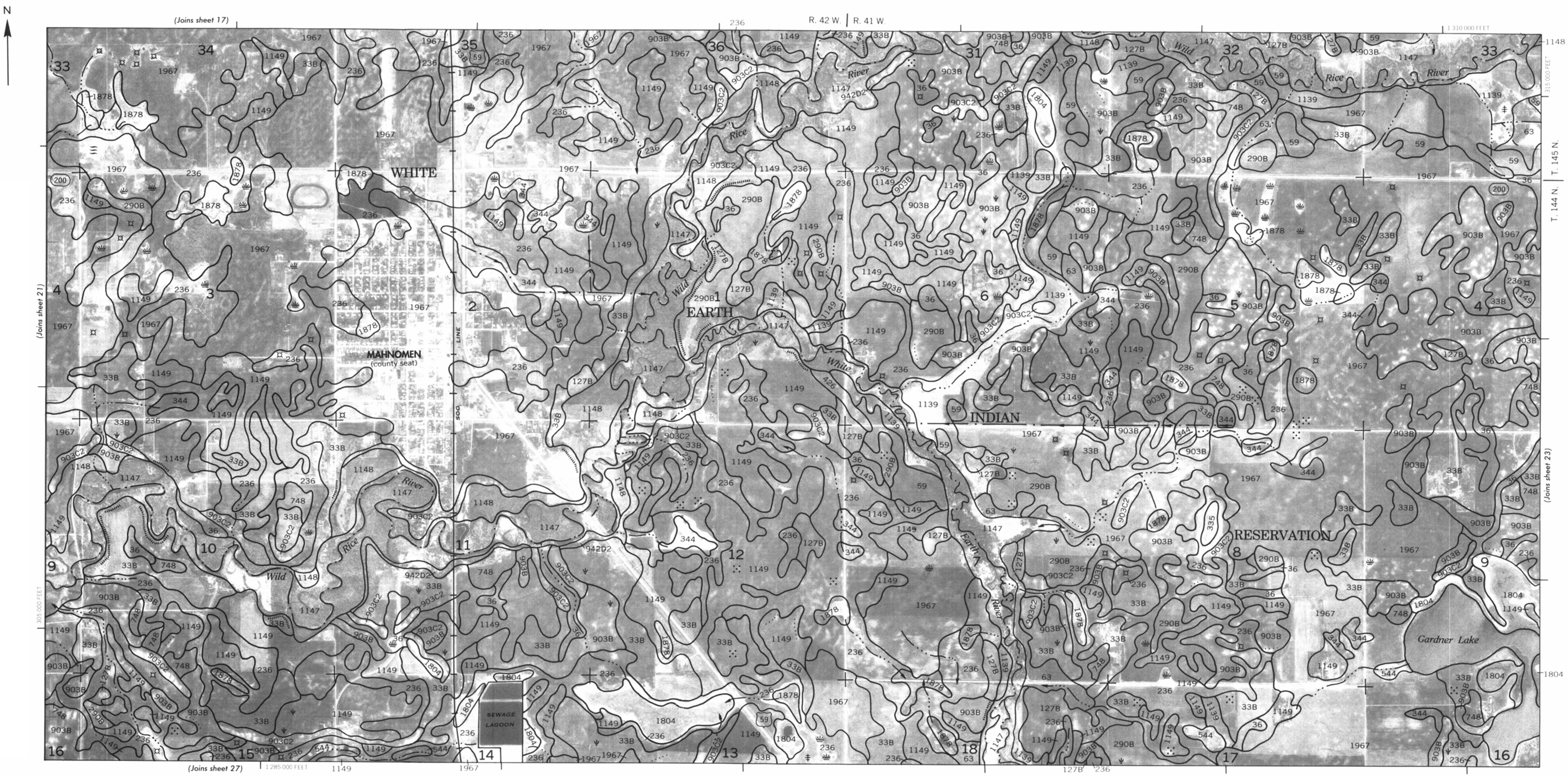


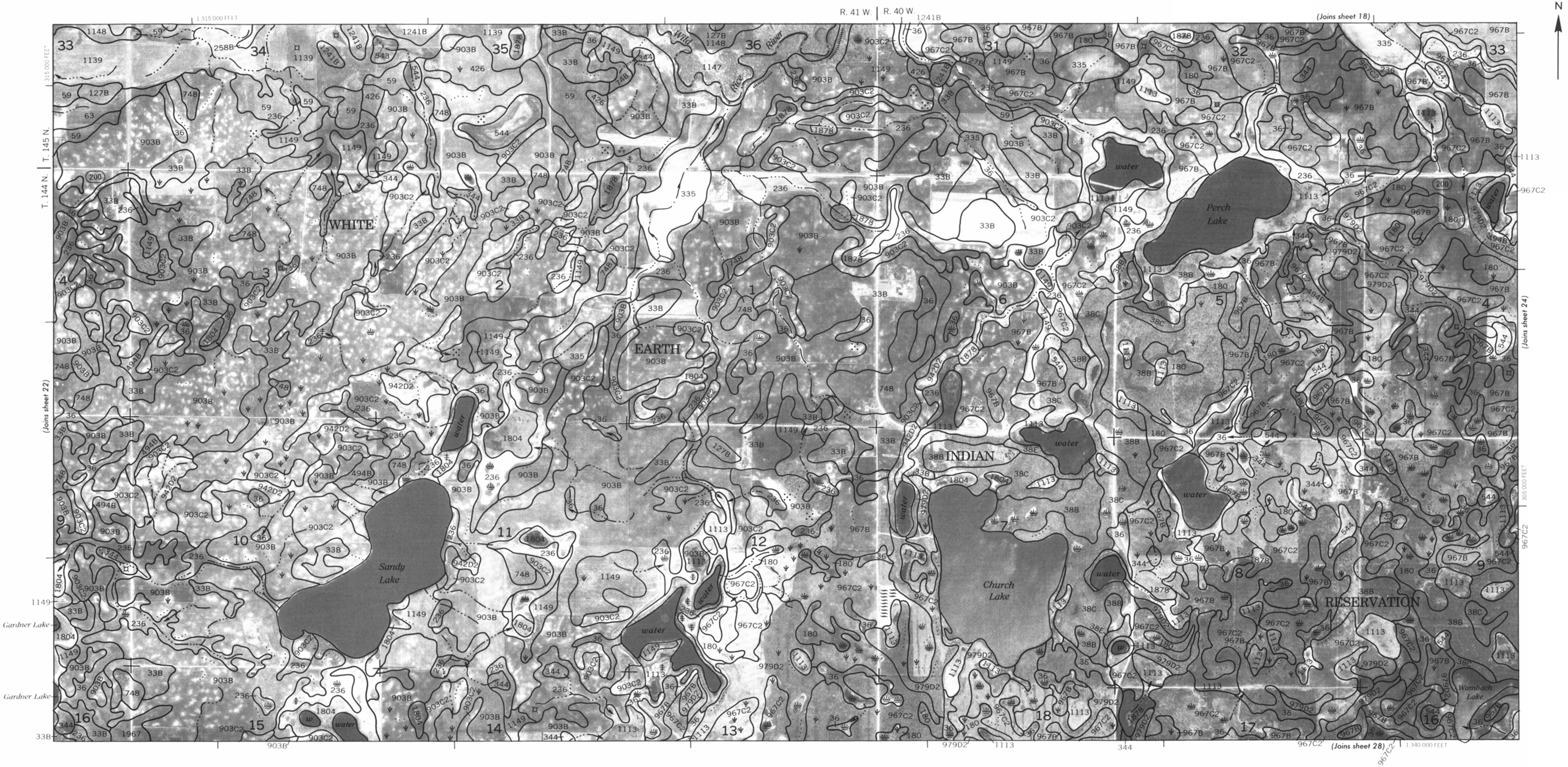
SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 20



SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 21




N
(Joins sheet 17)
R. 42 W. | R. 41 W.
1 310 000 FEET
315 000 FEET
T. 145 N.
T. 144 N.
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 27)
1 285 000 FEET
305 000 FEET
1804
WHITE
EARTH
INDIAN
RESERVATION
MAHNOMEN
(county seat)
Wild Rice River
White Earth River
Gardner Lake
SEWAGE LAGOON
LINE
200
59
33
34
35
36
31
32
33
4
3
2
1
6
5
4
9
10
11
12
7
8
9
16
15
14
13
18
17
16


N
1 315 000 FEET
R. 41 W. | R. 40 W.
(Joins sheet 18)
T. 145 N.
T. 144 N.
315 000 FEET
(Joins sheet 22)
(Joins sheet 24)
305 000 FEET
(Joins sheet 28)
1 340 000 FEET
WHITE
EARTH
INDIAN
RESERVATION
Wild Rice River
Perch Lake
Sandy Lake
Church Lake
Wambach Lake
Gardner Lake
Gardner Lake
water
33
34
35
36
31
32
33
4
3
2
1
6
5
4
9
10
11
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16
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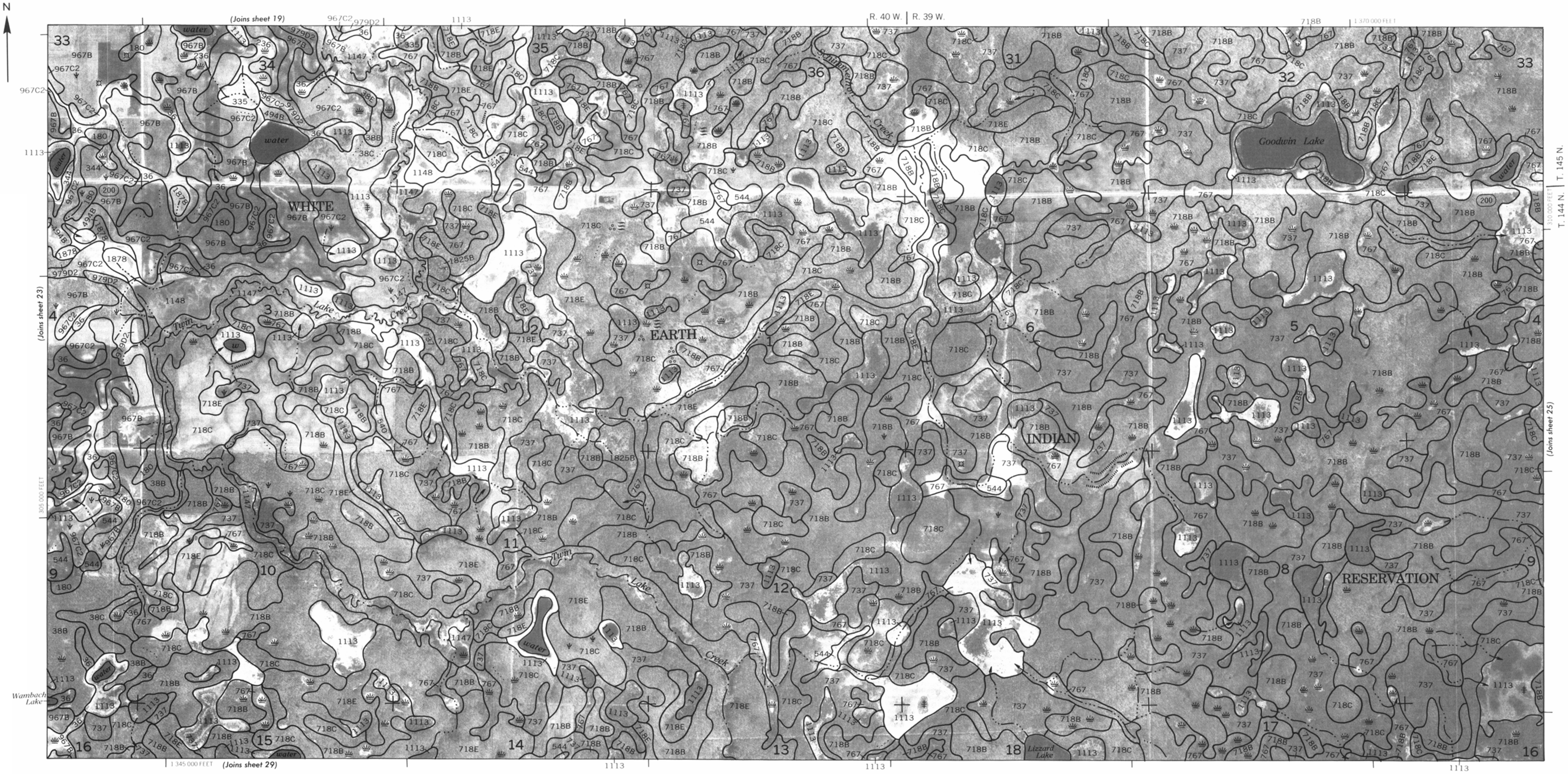
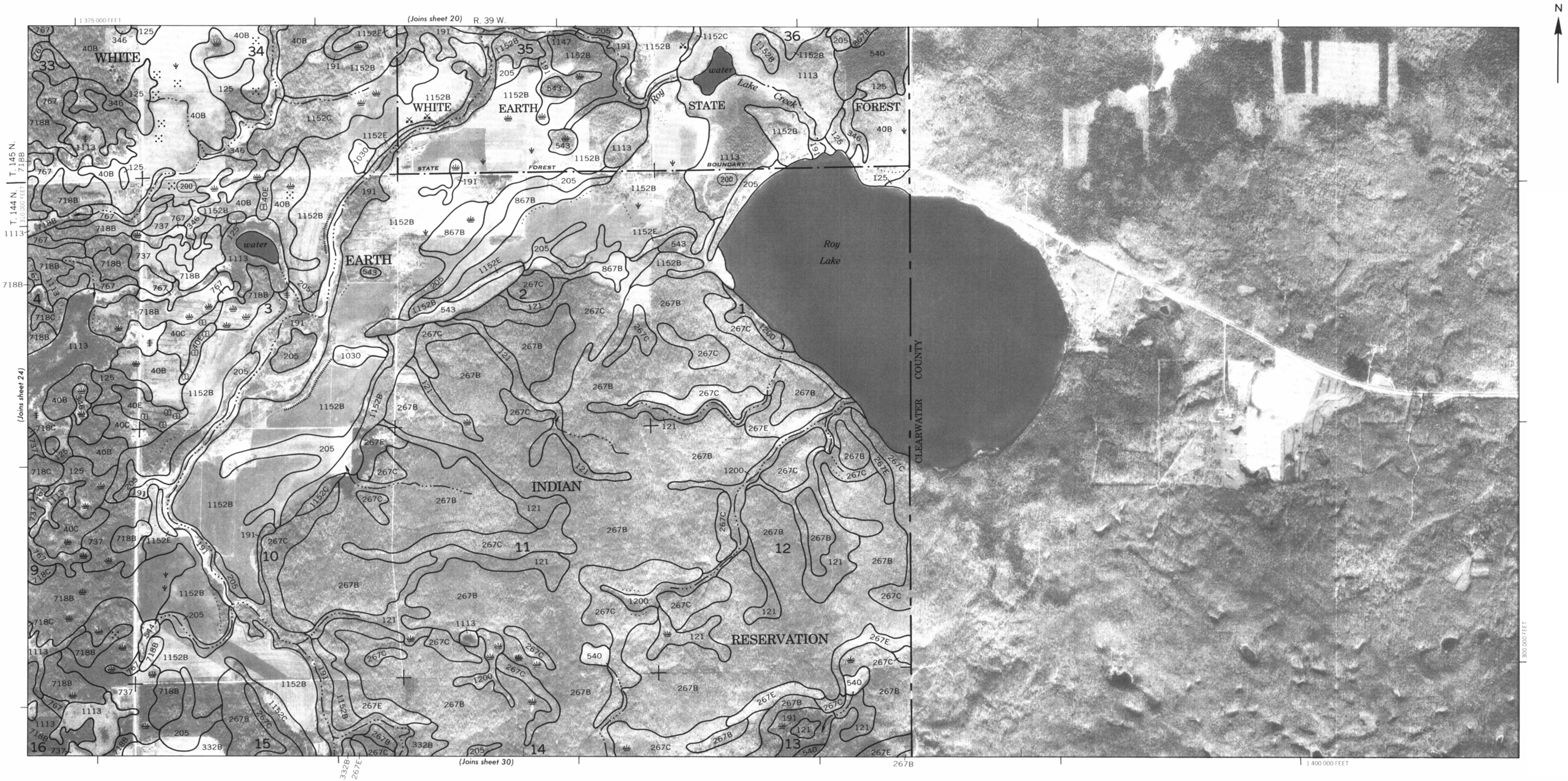
17
16

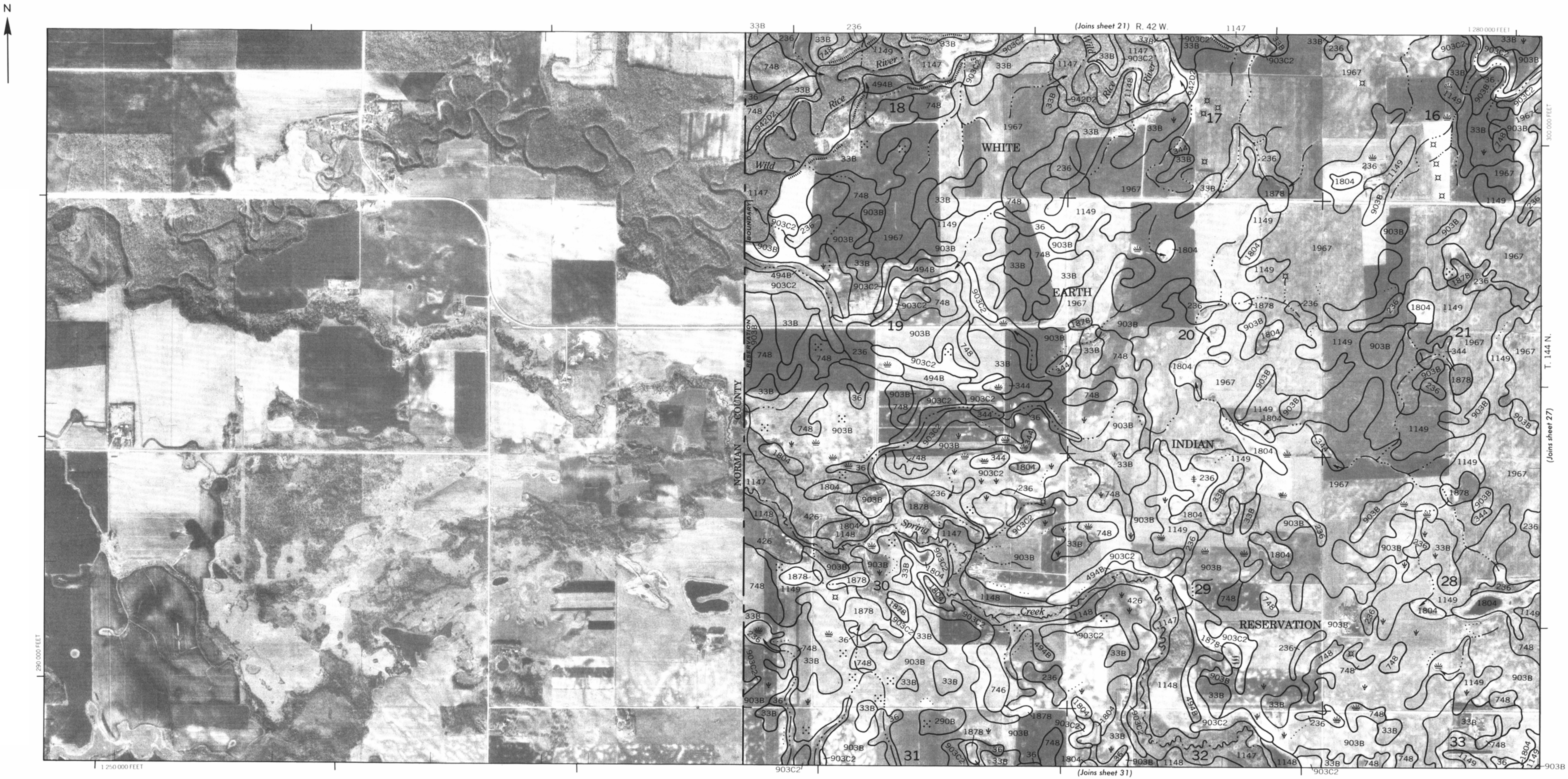
SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 24

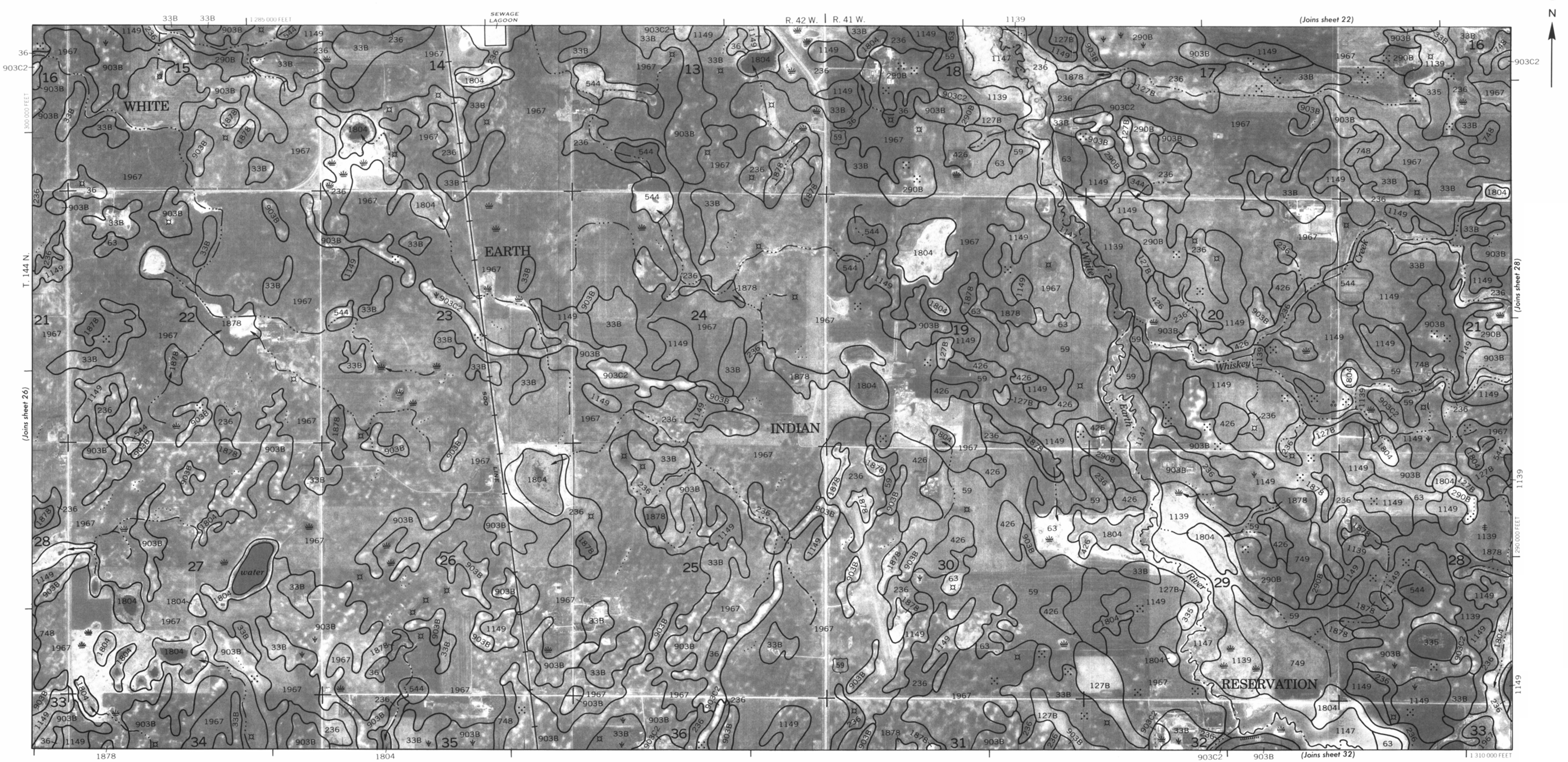


SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 25

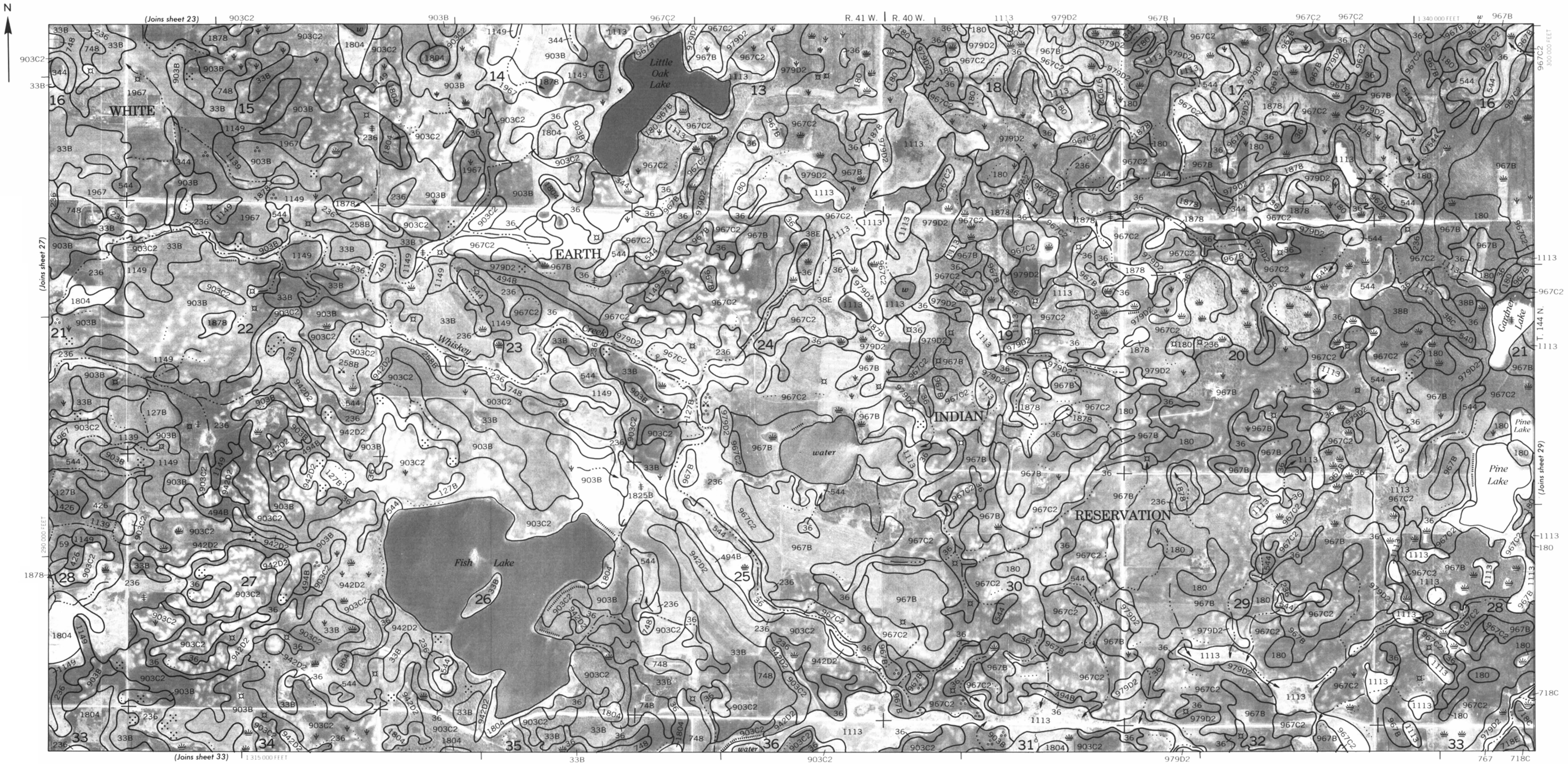


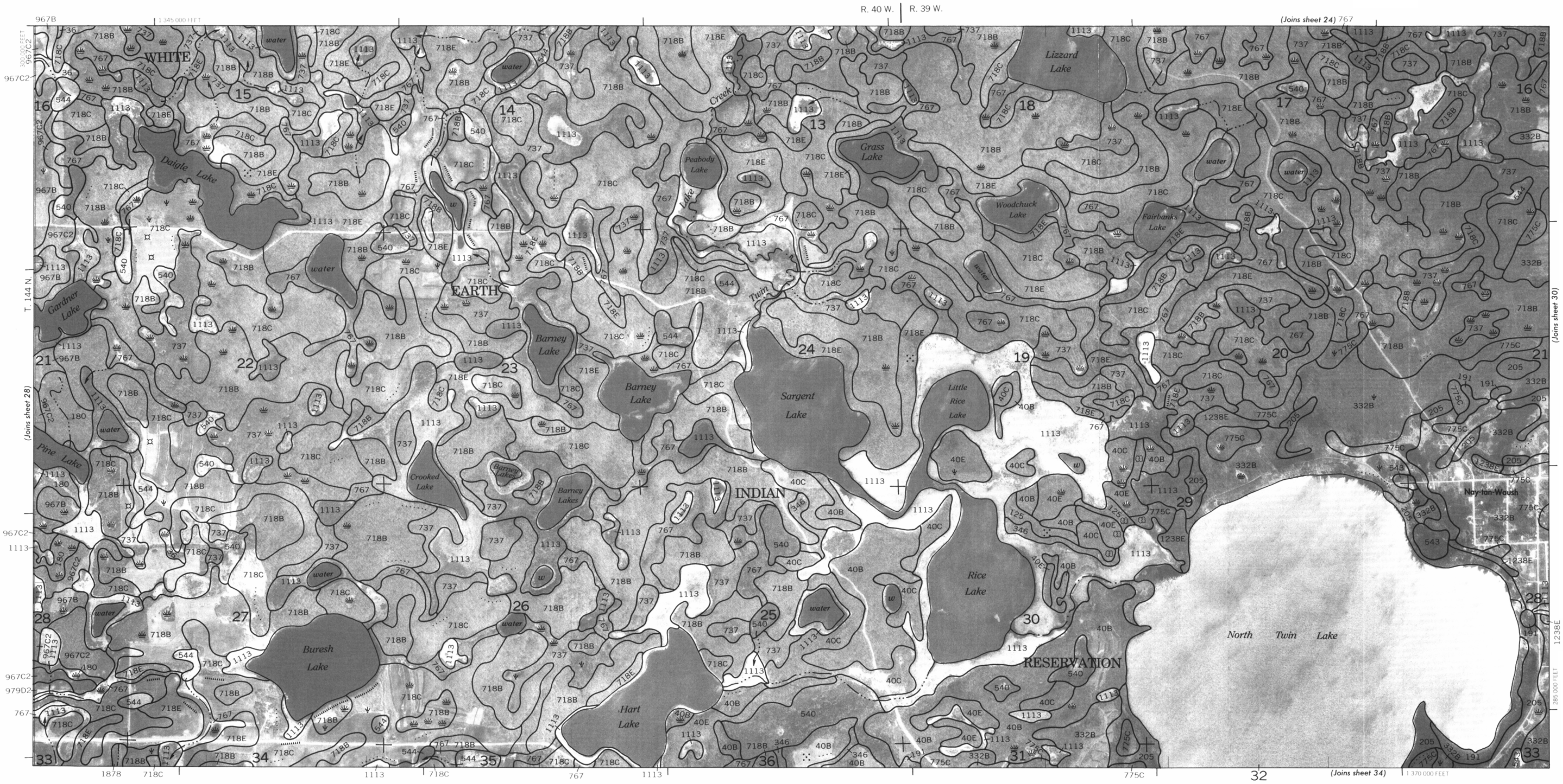
SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 26




27
N
SEWAGE LAGOON
1 285 000 FEET
R. 42 W.
R. 41 W.
(Joins sheet 22)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 32)
T. 144 N.
300 000 FEET
290 000 FEET
1 310 000 FEET
WHITE
EARTH
INDIAN
RESERVATION
White Earth River
Whiskey Creek
water
LINE
16
15
14
13
18
17
21
22
23
24
19
20
28
27
26
25
30
29
33
34
35
36
31
32
33B
36
903C2
1149
903B
290B
236
544
1804
1967
1878
127B
1139
1147
335
748
426
59
63
749

SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 28




N
R. 40 W.
R. 39 W.
T. 144 N.
1 345 000 FEET
1 370 000 FEET
300 000 FEET
285 000 FEET
(Joins sheet 24)
(Joins sheet 28)
(Joins sheet 30)
(Joins sheet 34)
WHITE
EARTH
INDIAN
RESERVATION
Daigle Lake
Gardner Lake
Pine Lake
Buresh Lake
Crooked Lake
Barney Lake
Barney Lakes
Peabody Lake
Twin Lake
Creek
Grass Lake
Lizzard Lake
Woodchuck Lake
Fairbanks Lake
Sargent Lake
Little Rice Lake
Rice Lake
Hart Lake
North Twin Lake
Nay-tah-Waush
water
13
14
15
16
17
18
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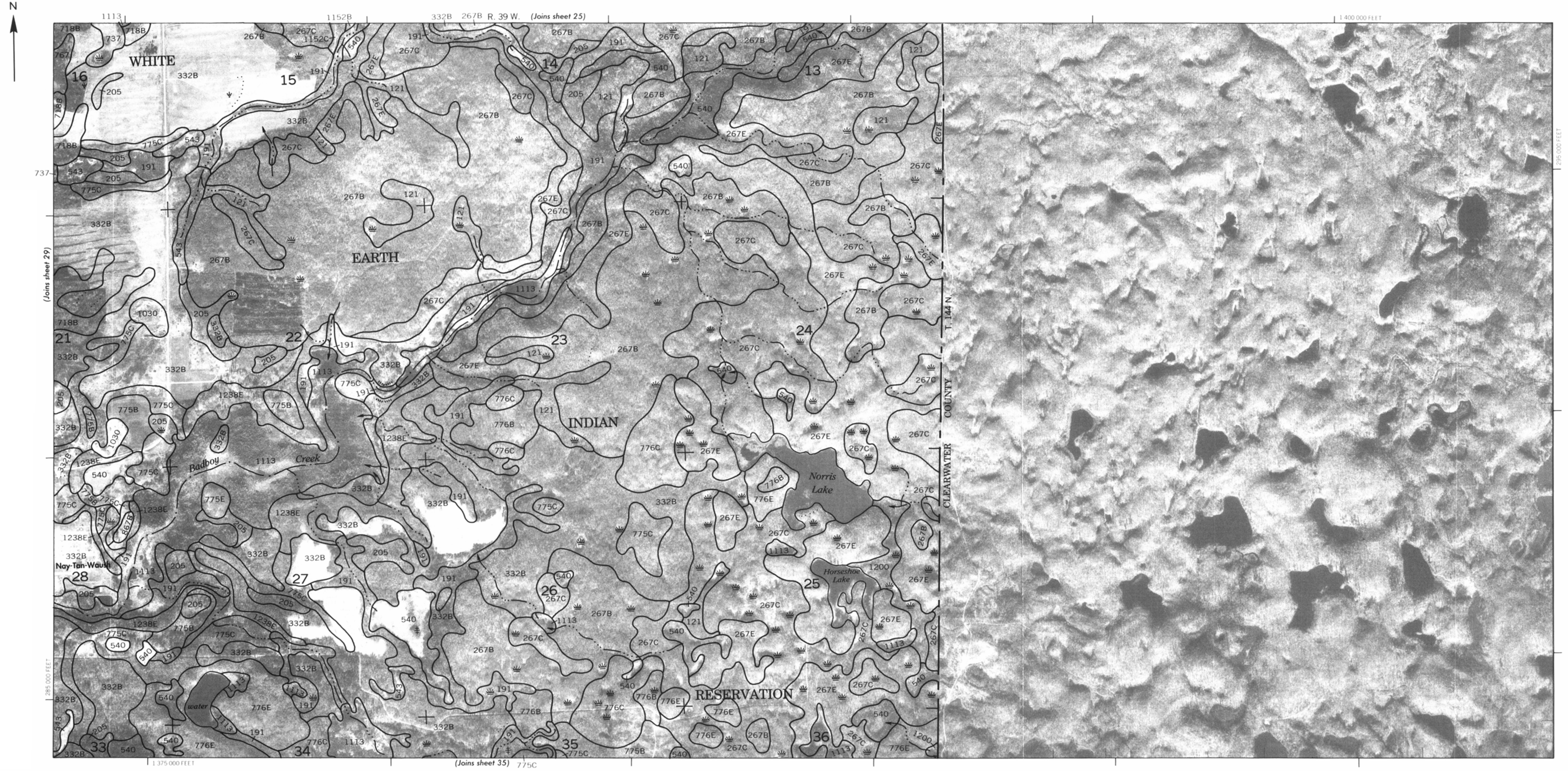
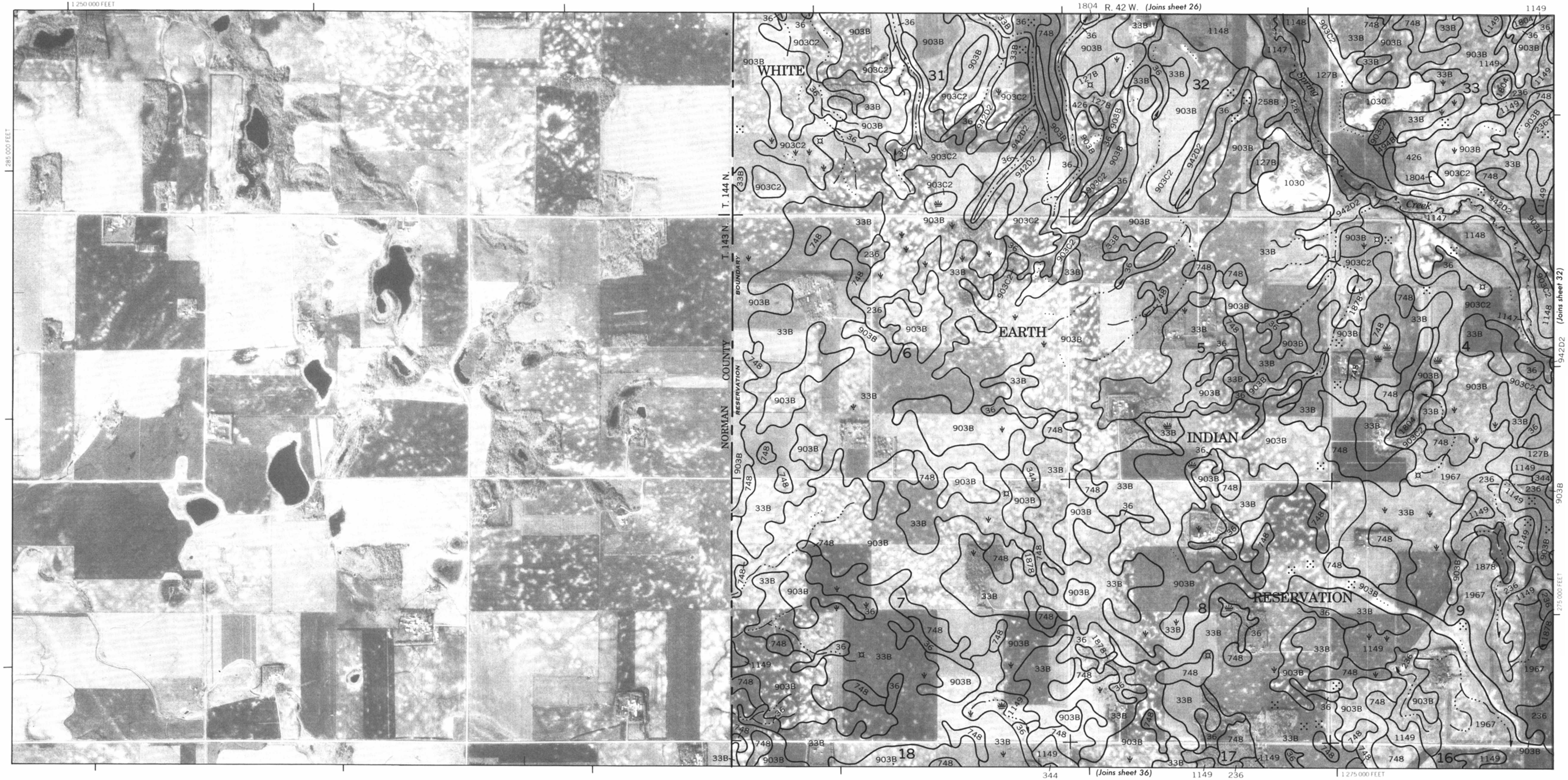
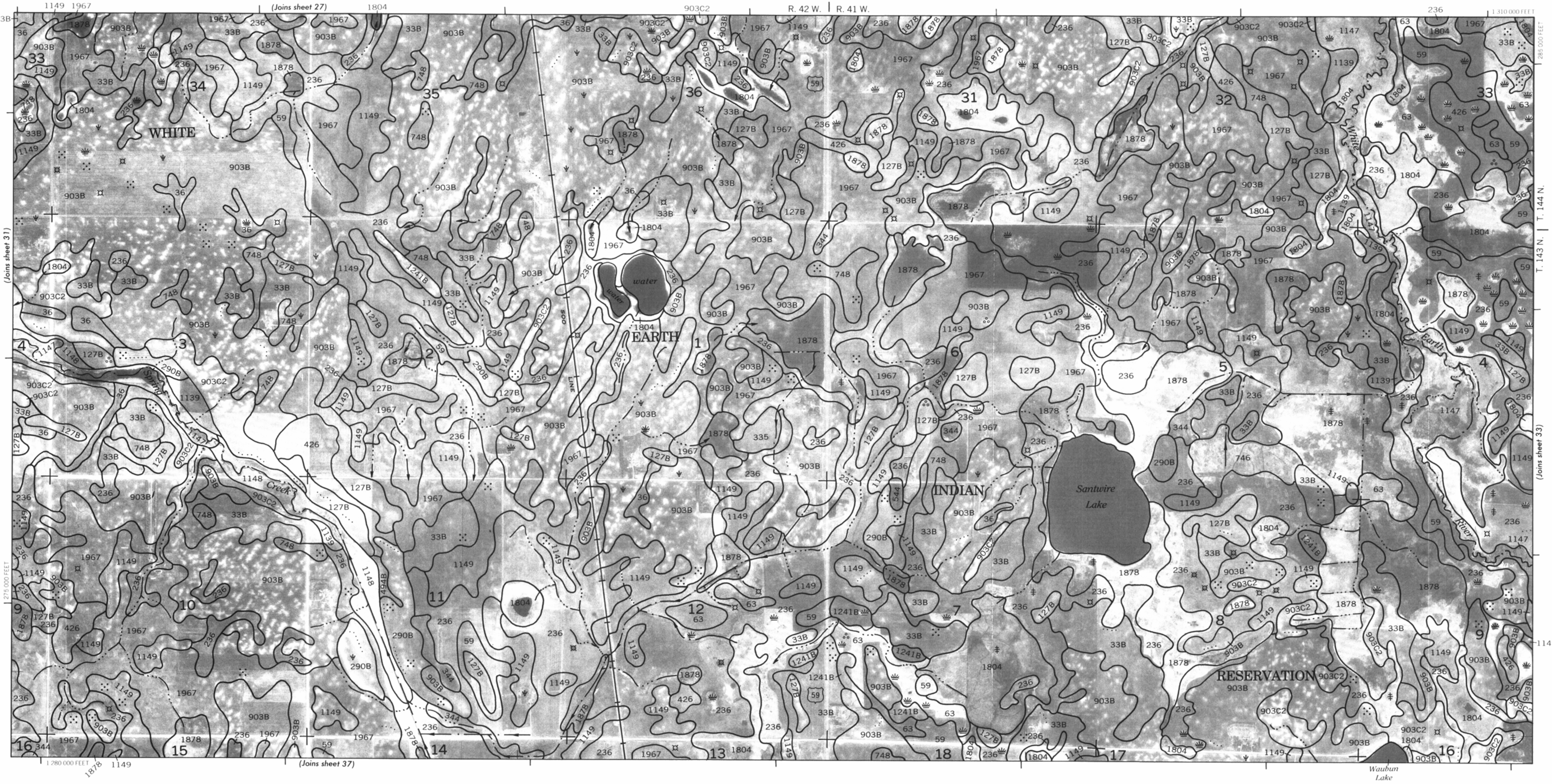
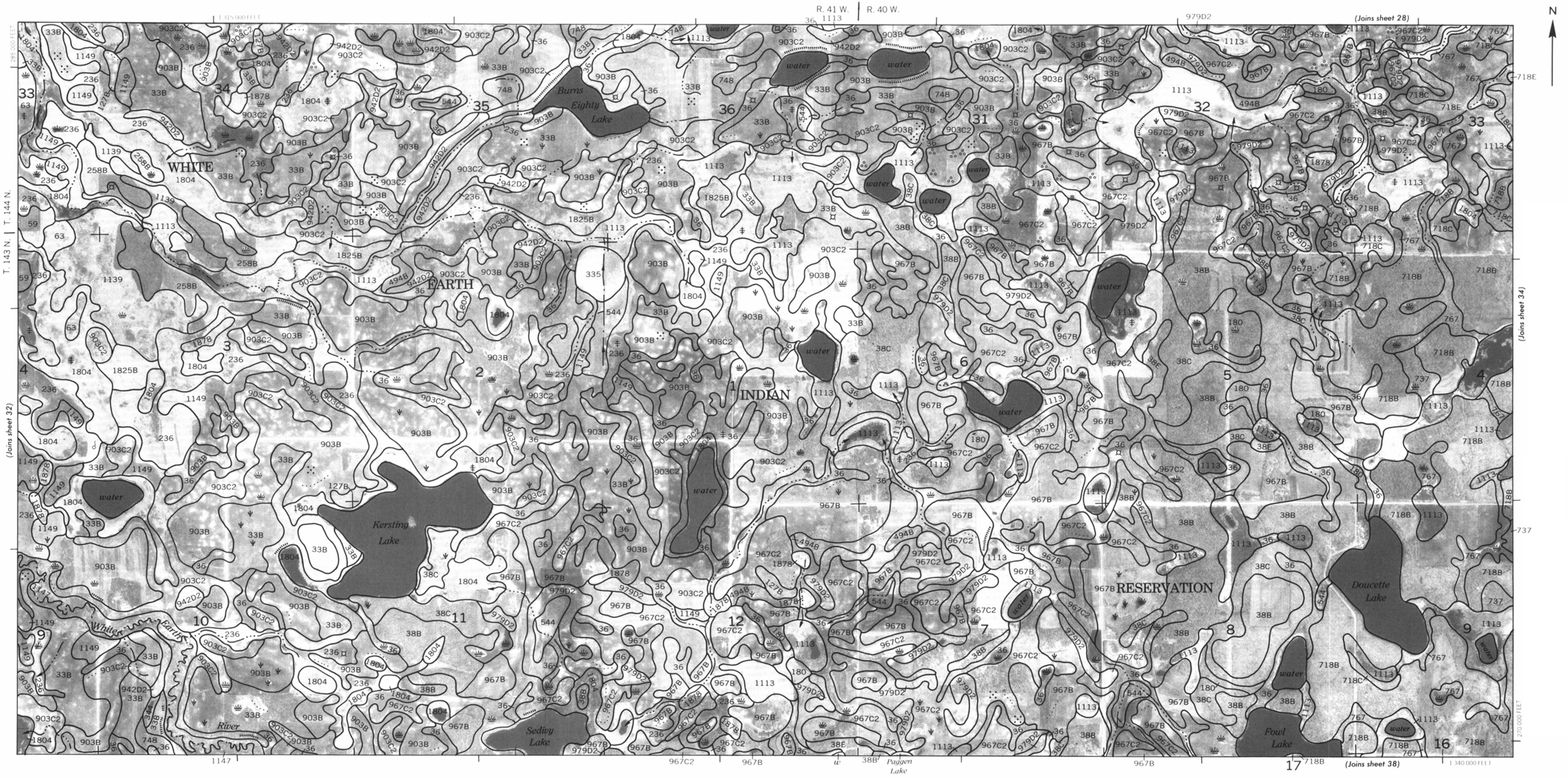
SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 30



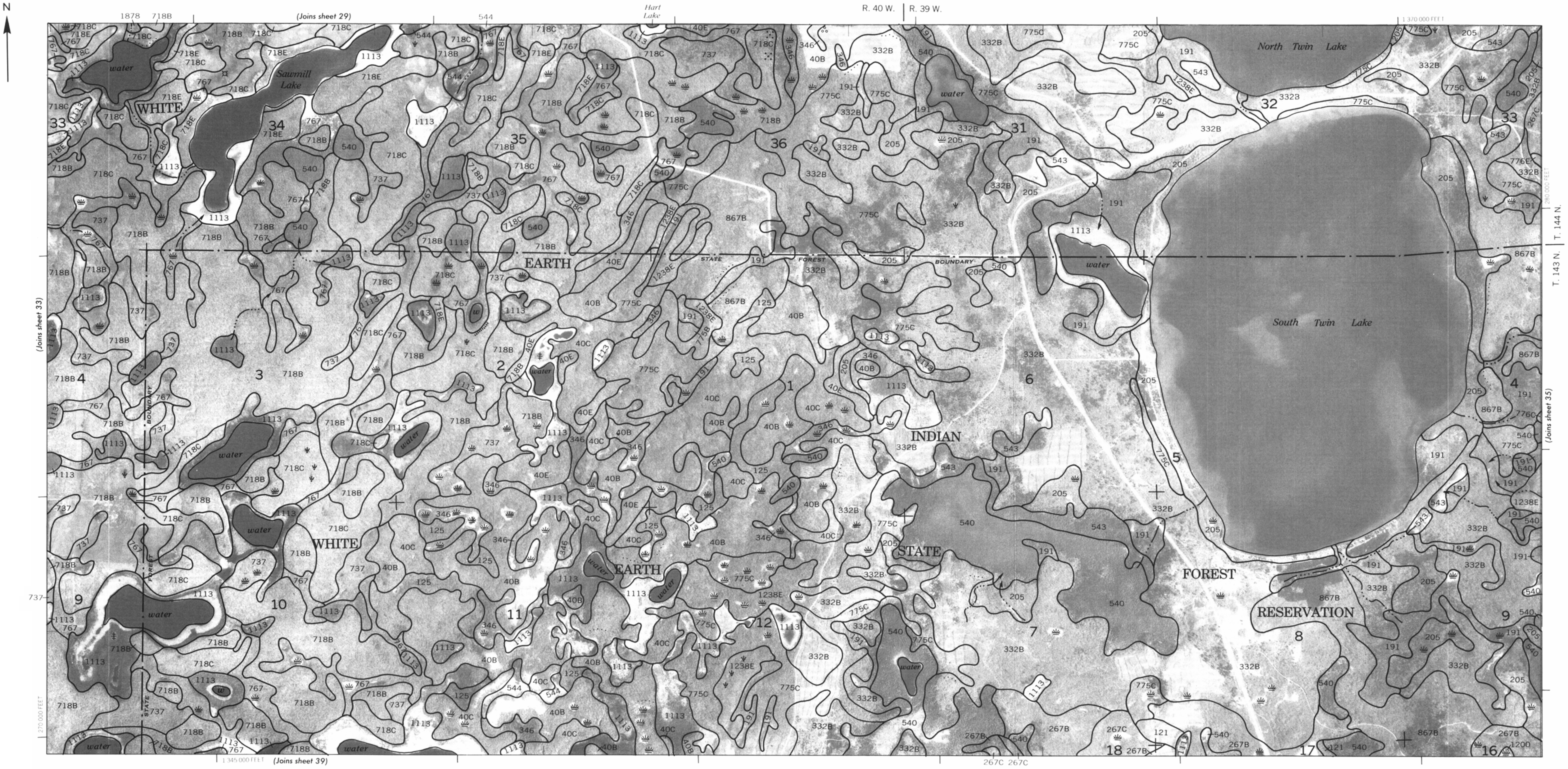
N

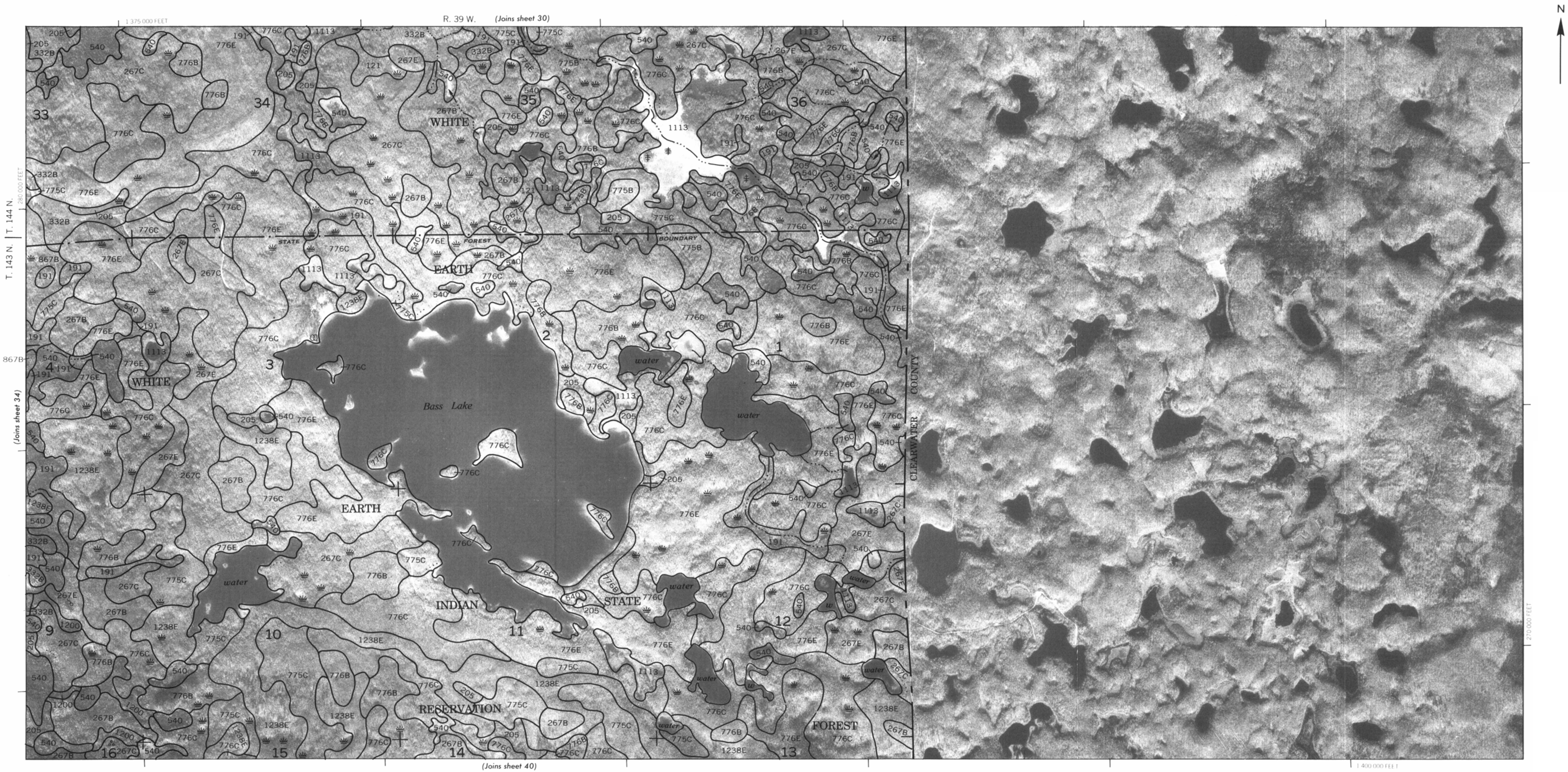

1 250 000 FEET
285 000 FEET
1804 R. 42 W. (Joins sheet 26) 1149
T. 144 N.
T. 143 N.
NORMAN COUNTY
RESERVATION BOUNDARY
WHITE
EARTH
INDIAN
RESERVATION
Spring
Creek
(Joins sheet 32)
275 000 FEET
(Joins sheet 36)
344
1149 236
1 275 000 FEET
31
32
33
6
5
4
7
8
9
18
17
16
36
33B
903B
903C2
942D2
748
127B
426
258B
1030
1147
1148
1149
236
344
1804
1878
1967


N
(Joins sheet 27)
(Joins sheet 31)
(Joins sheet 33)
(Joins sheet 37)
R. 42 W.
R. 41 W.
T. 144 N.
T. 143 N.
1 310 000 FEET
285 000 FEET
275 000 FEET
1 280 000 FEET
WHITE
EARTH
INDIAN
RESERVATION
Santwire Lake
Waubun Lake
water
Spring Creek
White Earth River
SOO LINE
59
33
34
35
36
31
32
4
3
2
1
6
5
9
10
11
12
7
8
16
15
14
13
18
17

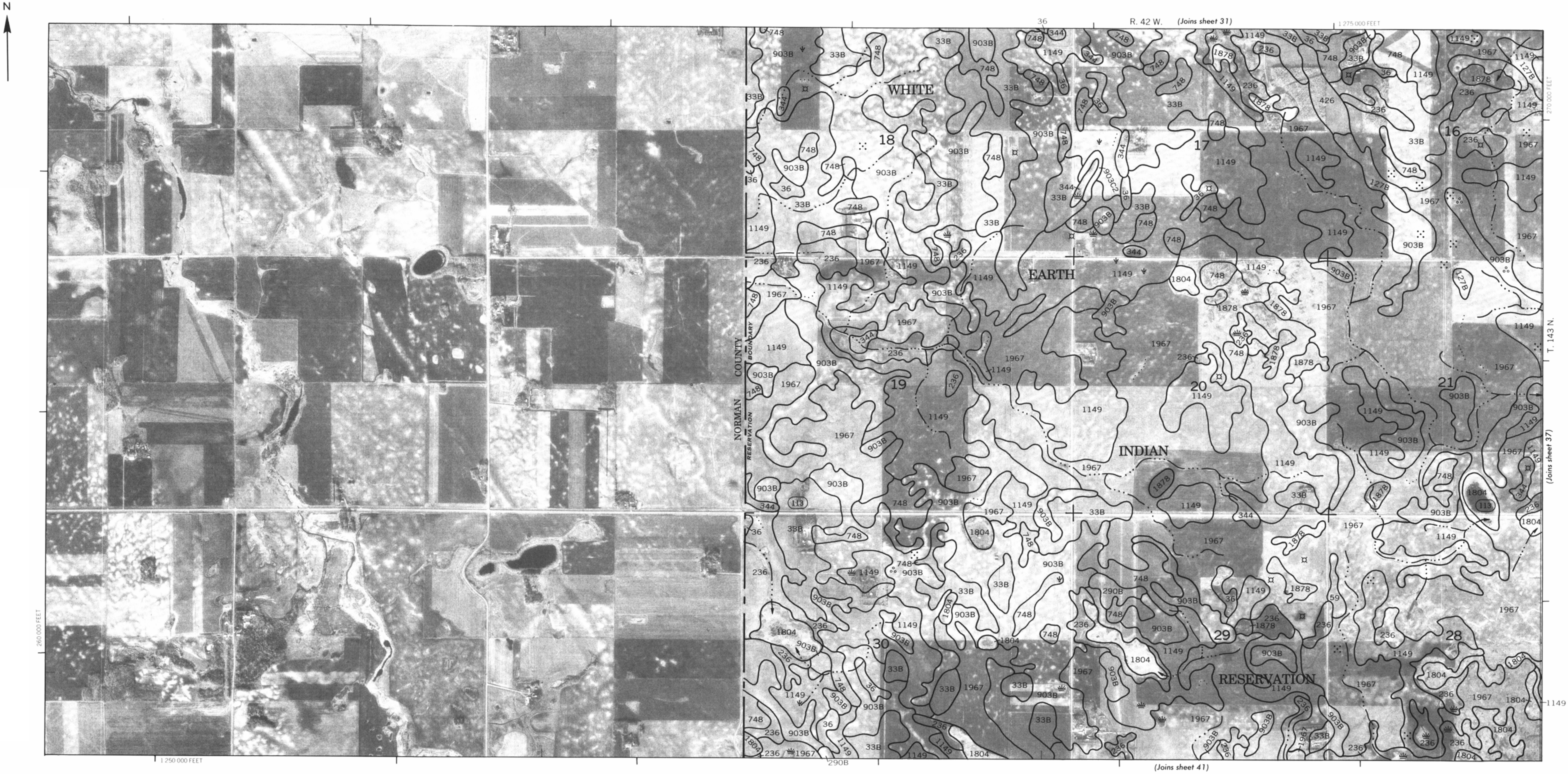

N
R. 41 W.
R. 40 W.
(Joins sheet 28)
(Joins sheet 34)
(Joins sheet 38)
(Joins sheet 32)
T. 144 N.
T. 143 N.
1 315 000 FEET
285 000 FEET
1 340 000 FEET
270 000 FEET
WHITE
EARTH
INDIAN
RESERVATION
Burns Eighty Lake
Kersting Lake
Doucette Lake
Fowl Lake
Sediwy Lake
Paggen Lake
White Earth River
water
33
34
35
36
31
32
33
4
3
2
1
6
5
4
9
10
11
12
7
8
9
16
17

SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 34

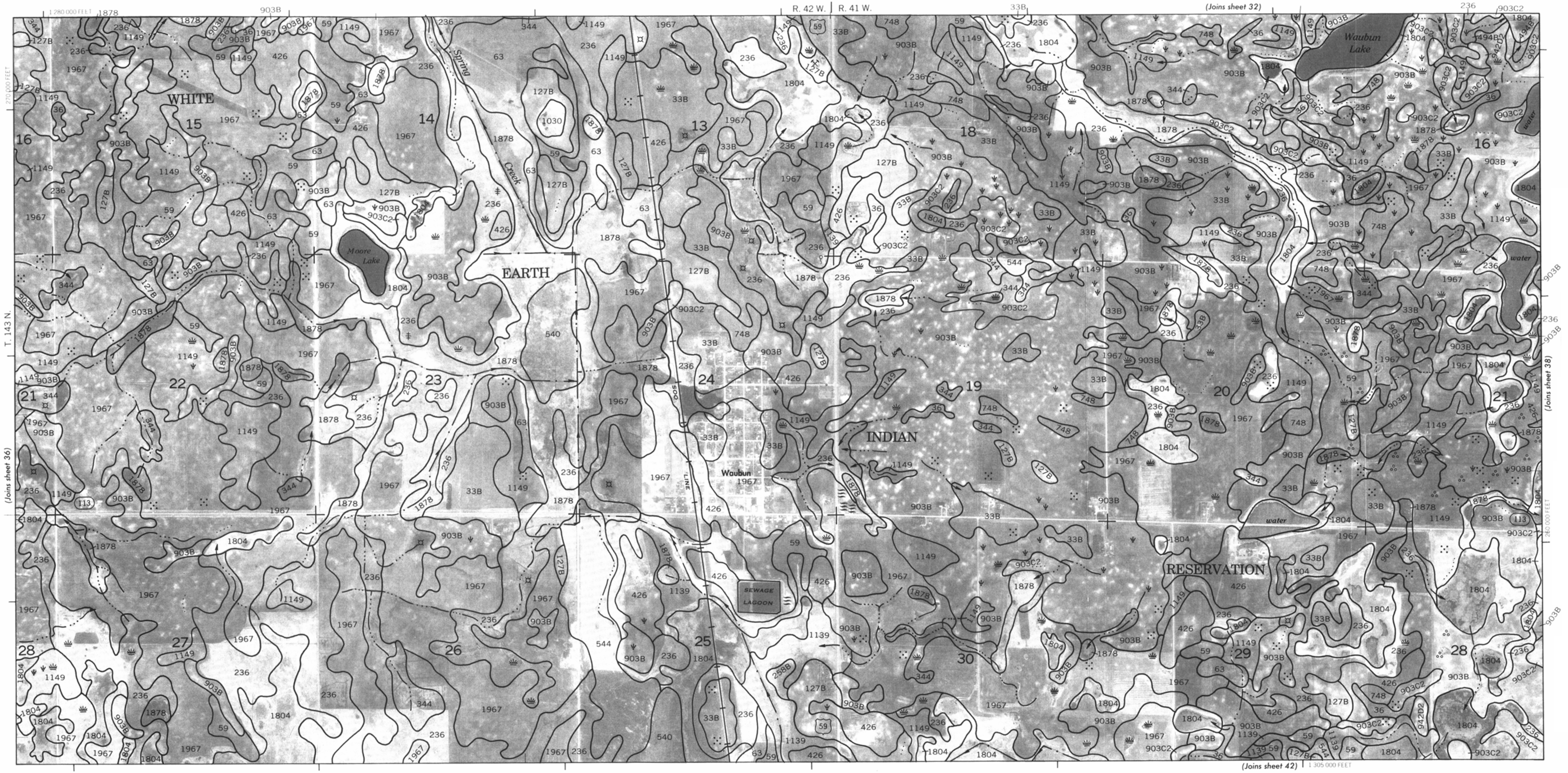


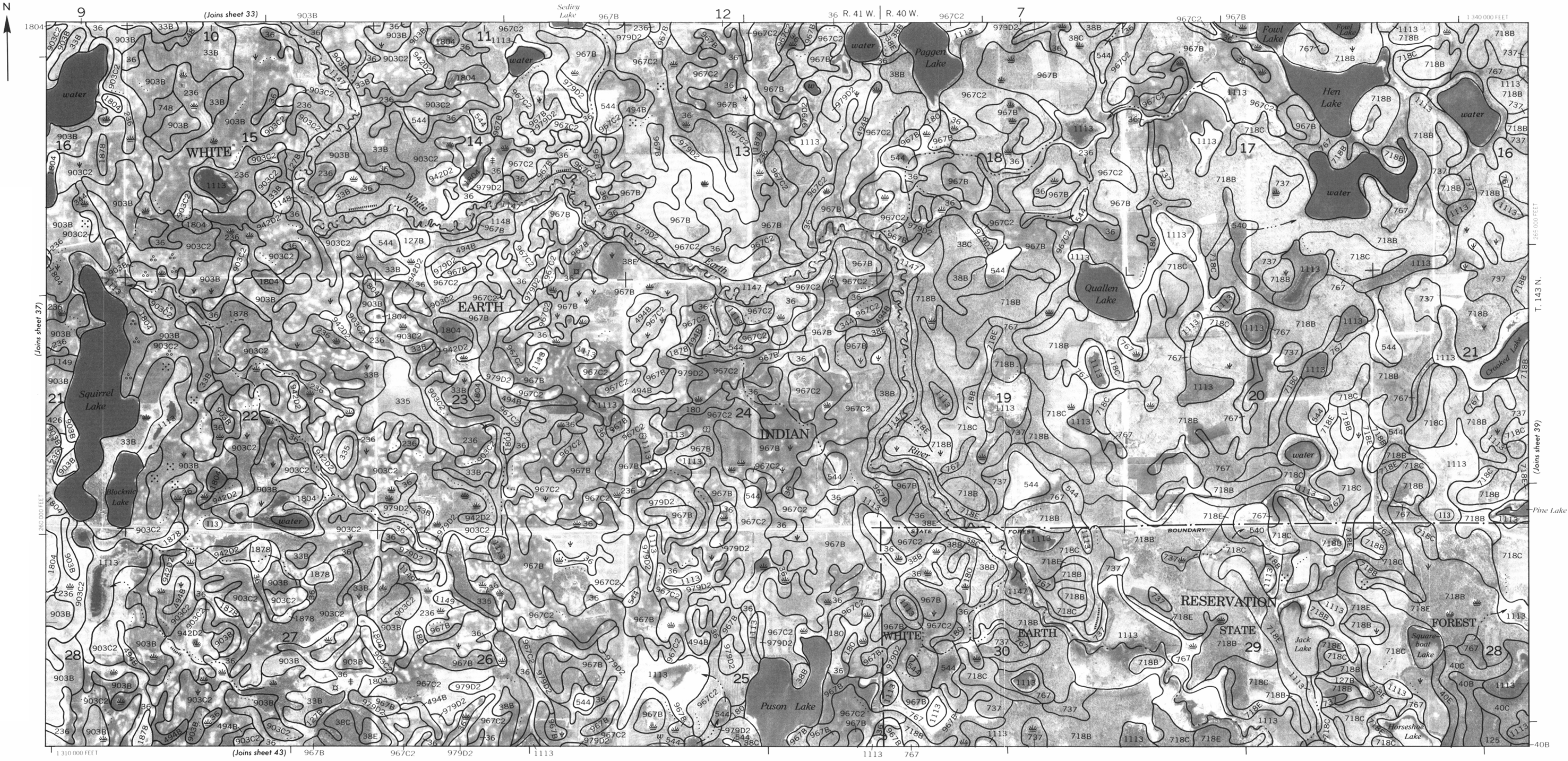

N
1 375 000 FEET
R. 39 W.
(Joins sheet 30)
280 000 FEET
T. 144 N.
T. 143 N.
867B
(Joins sheet 34)
(Joins sheet 40)
1 400 000 FEET
270 000 FEET
CLEARWATER COUNTY
WHITE EARTH STATE FOREST BOUNDARY
WHITE EARTH INDIAN RESERVATION
WHITE EARTH STATE FOREST
Bass Lake
water
w
33
34
35
36
1
2
3
4
9
10
11
12
13
14
15
16
121
191
205
267B
267C
267E
332B
540
775B
775C
776B
776C
776E
867B
1113
1200
1238E

SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 36



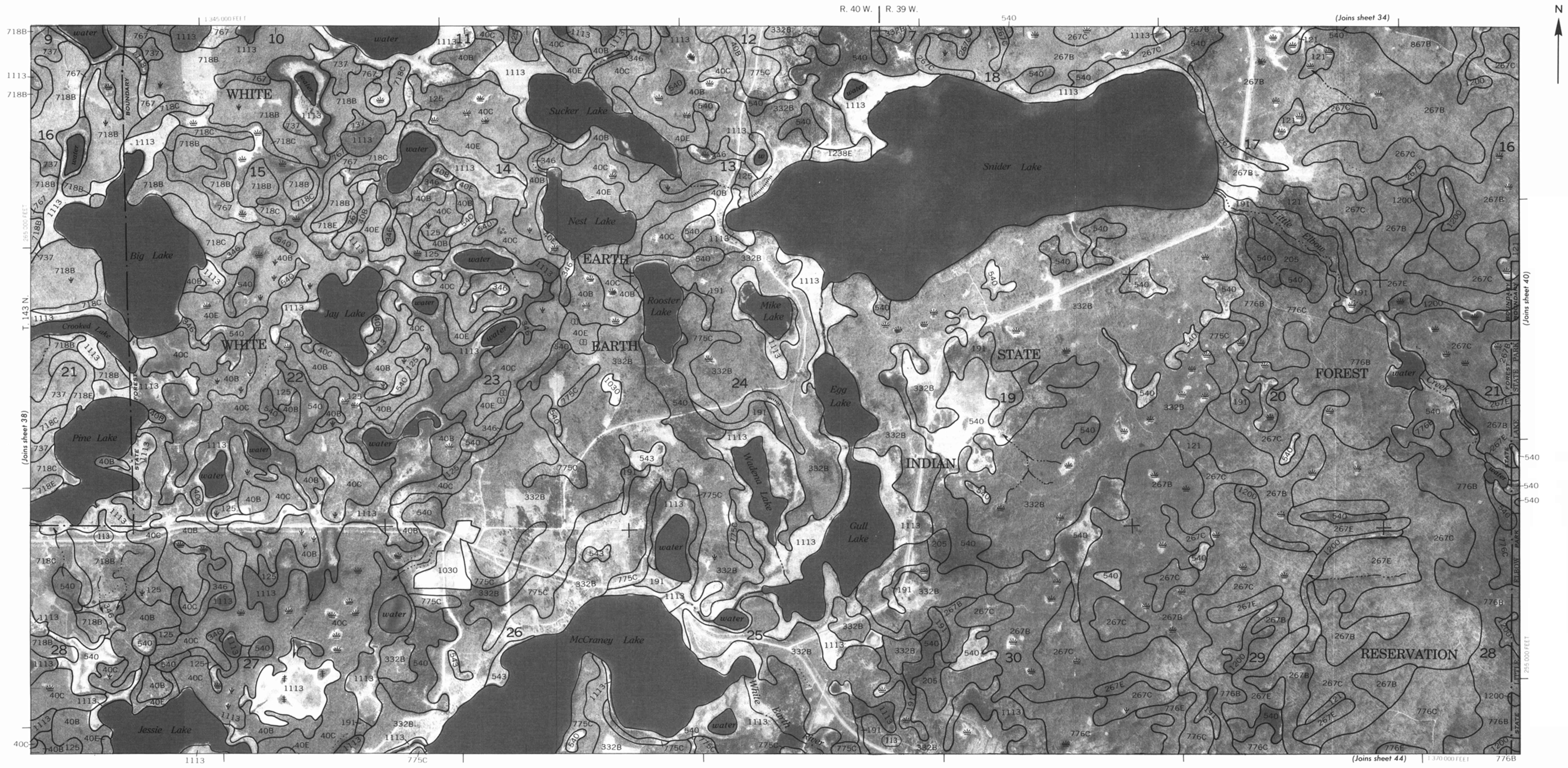
SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 37



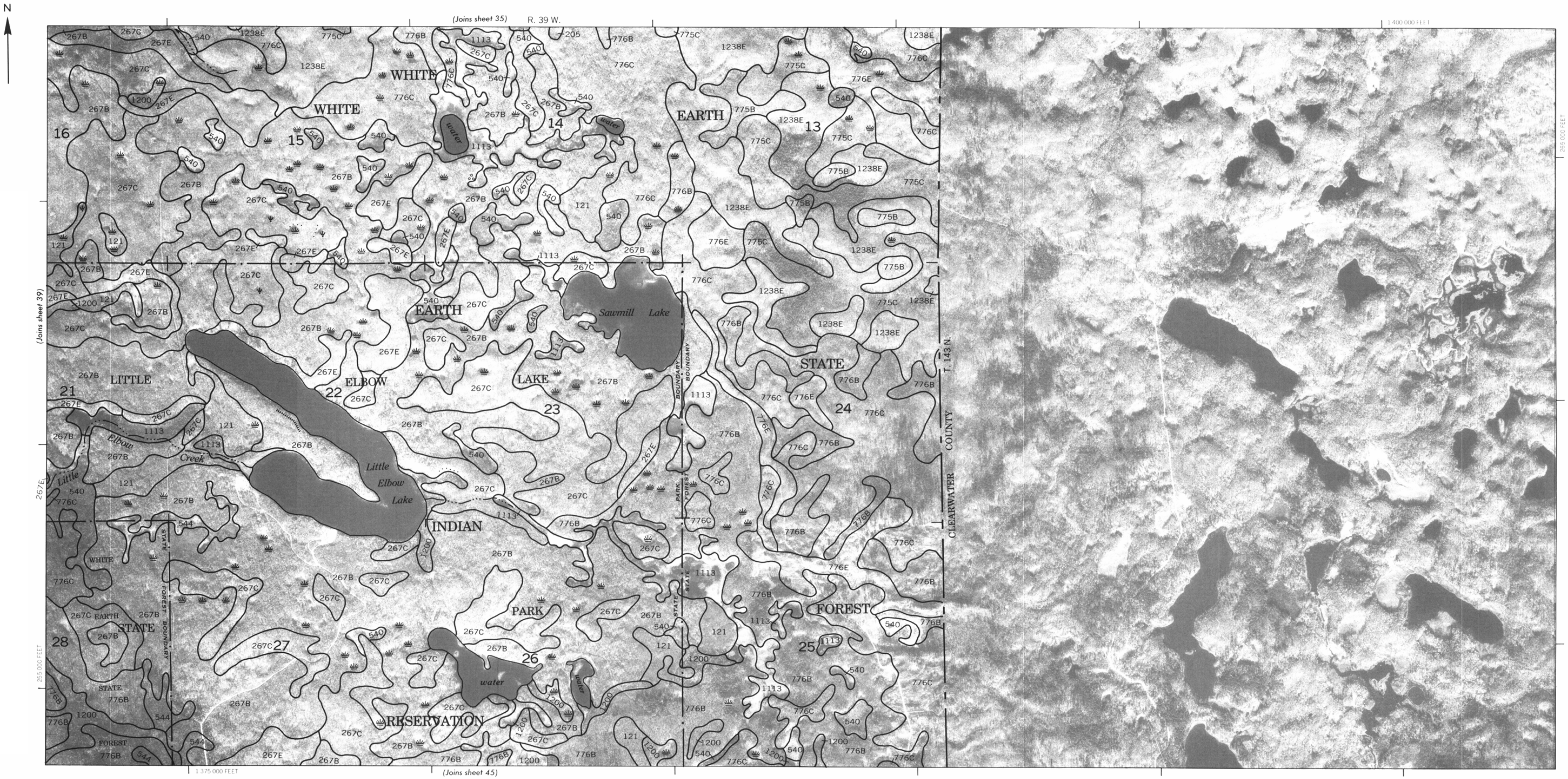

N
(Joins sheet 33)
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 43)
R. 41 W.
R. 40 W.
T. 143 N.
1 310 000 FEET
1 340 000 FEET
265 000 FEET
260 000 FEET
WHITE EARTH INDIAN RESERVATION
WHITE EARTH STATE FOREST
STATE FOREST BOUNDARY
White Earth River
Sedivy Lake
Paggen Lake
Fowl Lake
Hen Lake
Qualllen Lake
Crooked Lake
Pine Lake
Squirrel Lake
Blocknic Lake
Puson Lake
Jack Lake
Squareboat Lake
Horseshoe Lake
water
9
10
11
12
7
14
13
18
17
16
15
21
22
23
24
19
20
28
27
26
25
30
29

SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 39

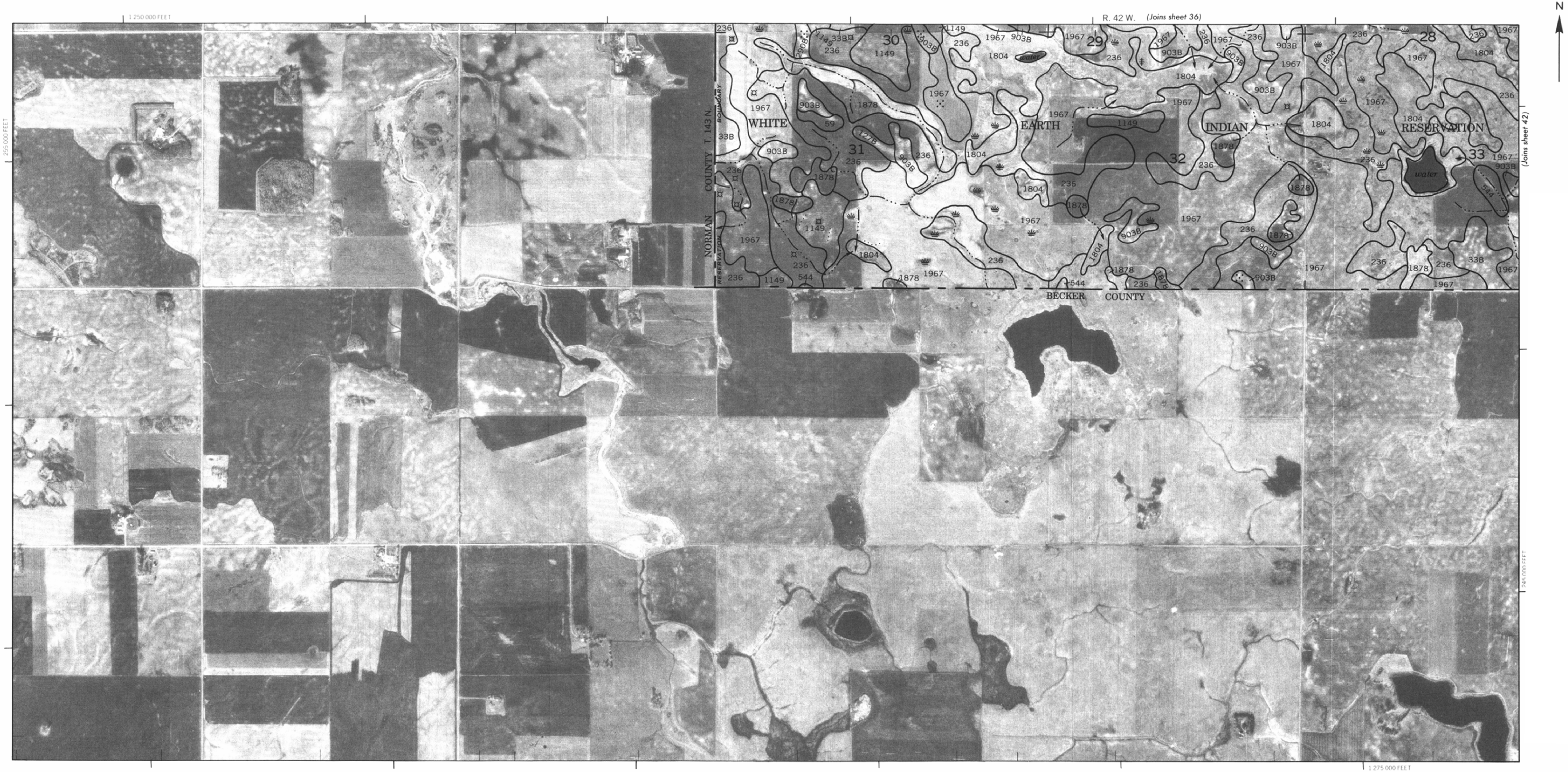
39

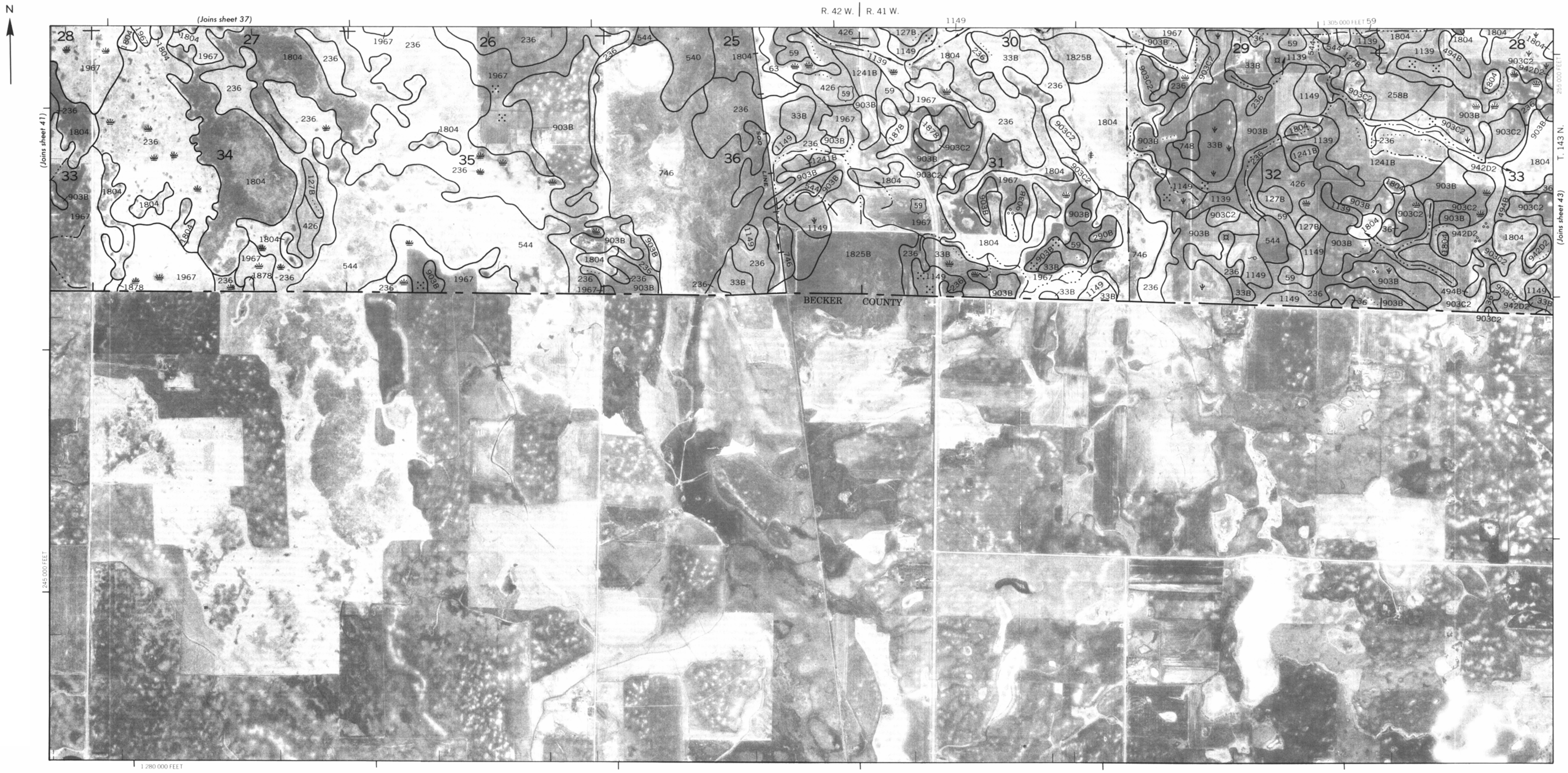


SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 40

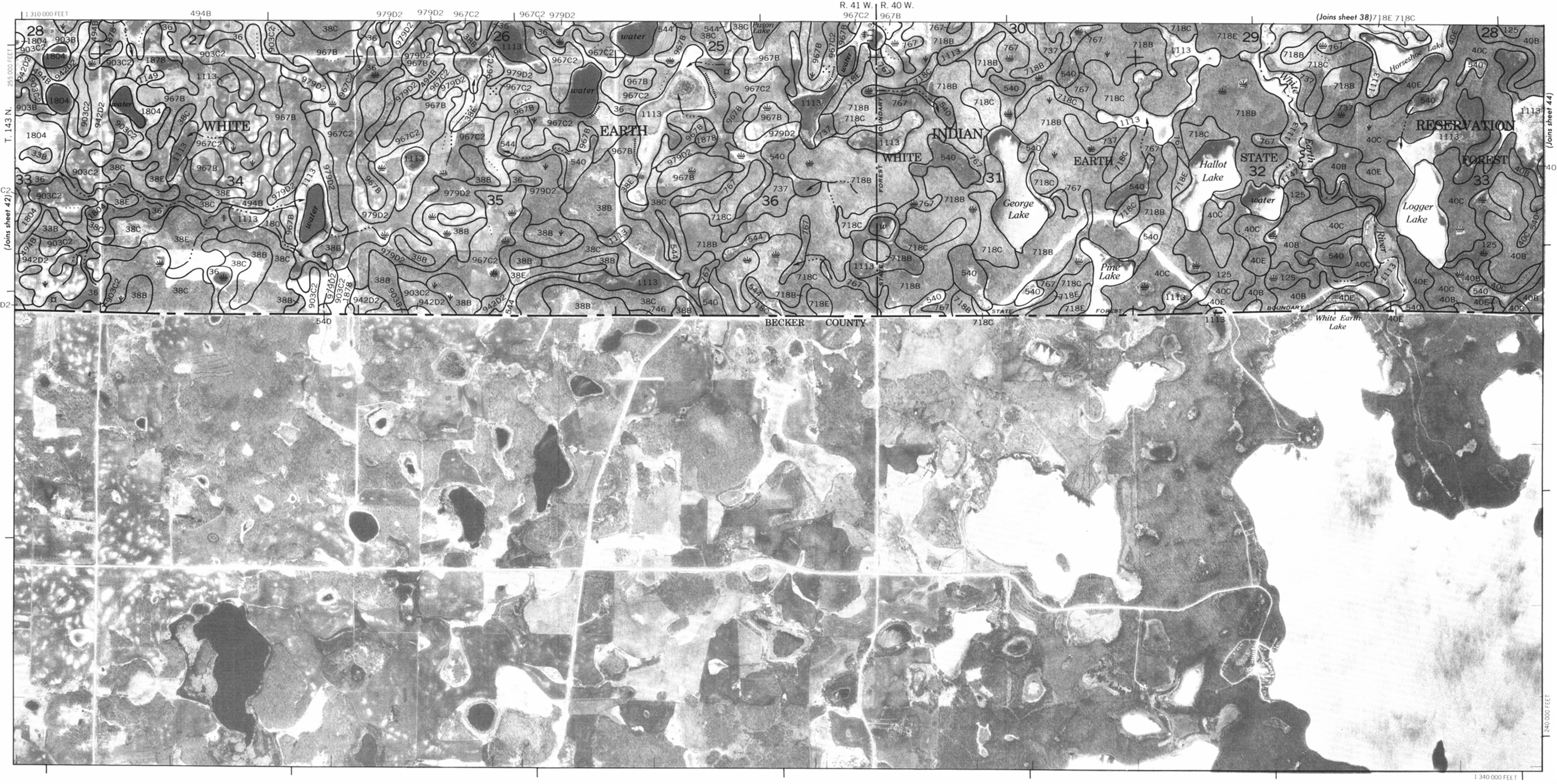


SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 41

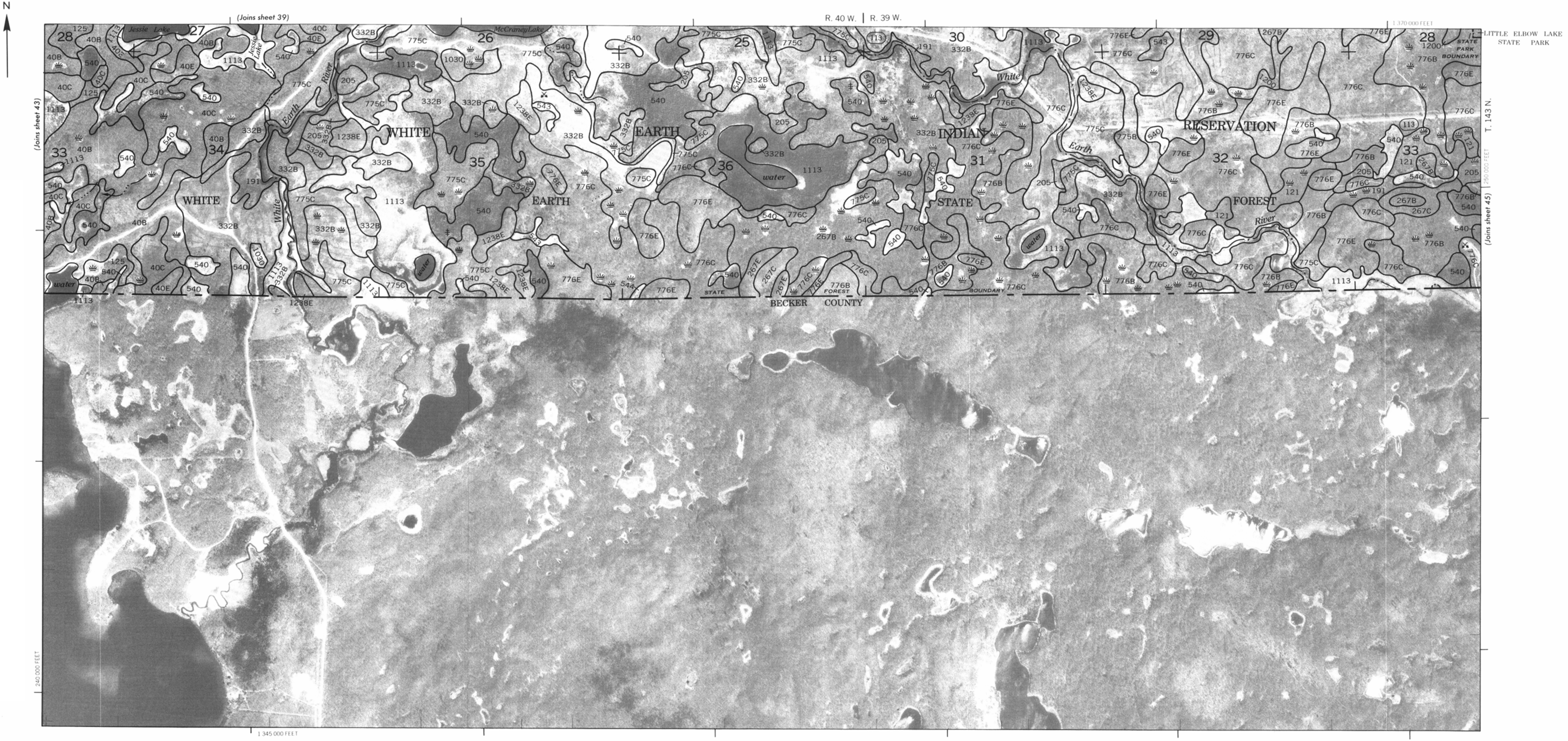


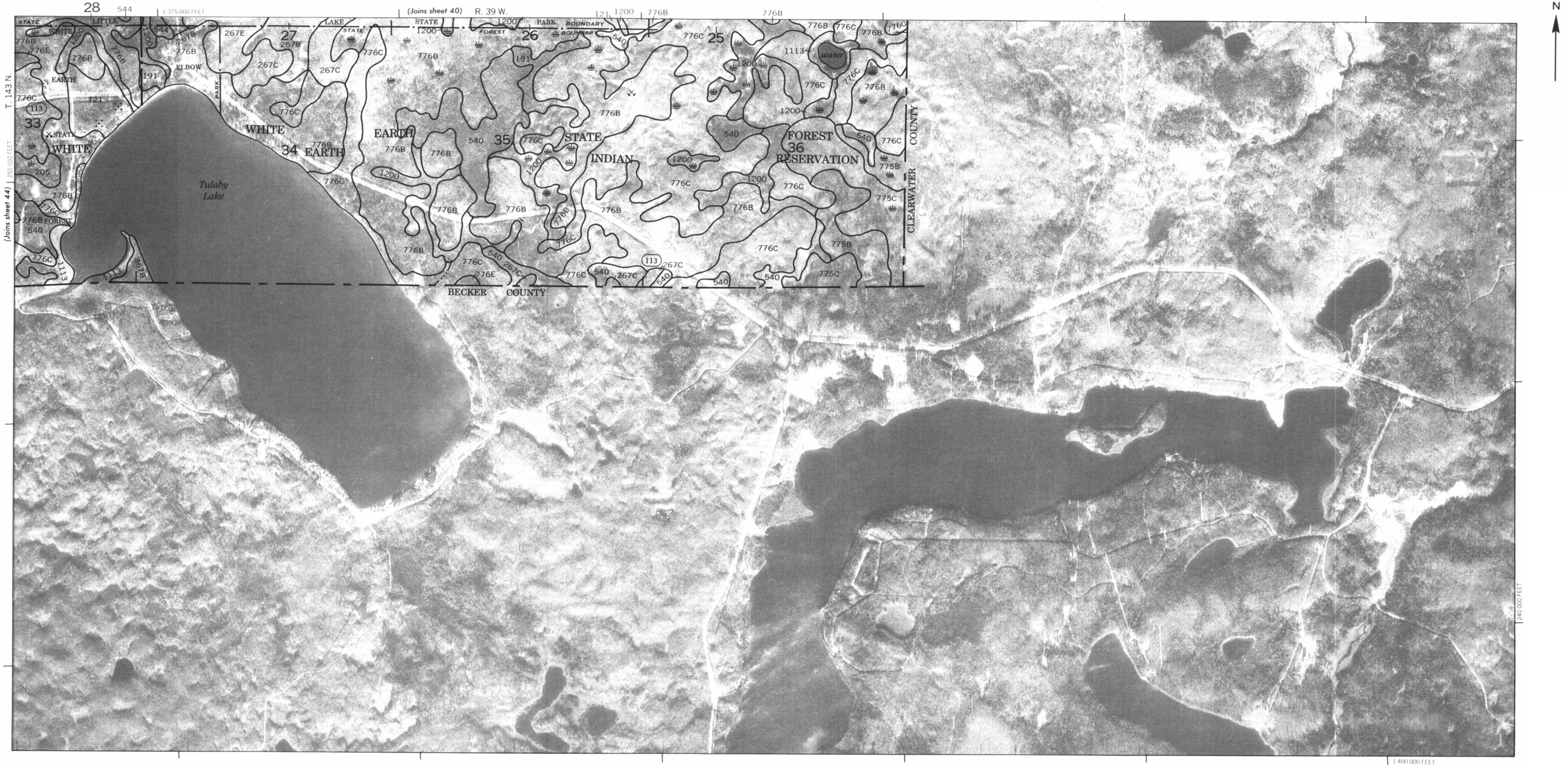

N
(Joins sheet 37)
R. 42 W.
R. 41 W.
1 305 000 FEET
T. 143 N.
(Joins sheet 41)
(Joins sheet 43)
BECKER COUNTY
245 000 FEET
1 280 000 FEET
LINE
59
28
27
26
25
30
29
28
33
34
35
36
31
32
33
1804
1967
236
903B
127B
426
544
1878
540
746
33B
1149
1241B
1139
1825B
903C2
942D2
494B
258B
290B
748
63

SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 43



SOIL SURVEY OF MAHNOMEN COUNTY, MINNESOTA — SHEET NUMBER 44




N
28
544
1 375 000 FEET
(Joins sheet 40)
R. 39 W.
121
1200
776B
T. 143 N.
250 000 FEET
(Joins sheet 44)
STATE
LITTLE
WHITE
LAKE
EARTH
ELBOW
PARK
STATE
FOREST
BOUNDARY
27
26
25
33
34
35
36
WHITE
EARTH
STATE
INDIAN
FOREST
RESERVATION
Tulaby Lake
water
CLEARWATER
COUNTY
BECKER
COUNTY
776B
776C
776E
267B
267C
267E
191
121
113
205
540
1113
1200
775B
775C
867B
1 400 000 FEET
240 000 FEET